SOLAR HOT WATER SYSTEM INSTALLED AT DAY'S INN MOTEL, JACKSONVILLE, FLORIDA

Prepared from documents furnished by

Day's Inn of America, Inc.
2751 Buford Highway, N. E.
Atlanta, Georgia 30324

Under Contract DOE EG-77-G-01-1632

Monitored by

National Aeronautics and Space Administration
George C. Marshall Space Flight Center, Alabama 35812

For the U. S. Department of Energy

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This final report describes the solar energy hot water system installed in the Days Inns of America, Inc., Days Inn Motel (120 rooms) I-95 and Cagle Road Jacksonville, Florida. The solar system was designed by ILI, Incorporated to provide 65 percent of the hot water demand. The system is one of eleven systems planned under this grant. Water [in the Solar Energy Products, Model CU-30ww liquid flat plate collector (900 square feet) system] automatically drains into the 1000 gallon lined and vented steel storage tank when the pump is not running. Heat is transferred from storage to Domestic Hot Water (DHW) tanks through a tube and shell heat exchanger. A circulating pump between the DHW tanks and heat exchanger enables solar heated water to help make up DHW standby losses. All pumps are controlled by differential temperature. This system was turned on June 19, 1979. The solar components were partly funded ($15,823 of $31,823 cost) by the Department of Energy under Grant EG-77-G-01-1632 with the technical management being done by NASA/George C. Marshall Space Flight Center, Huntsville, Alabama.
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<td>Pump Capacity Chart</td>
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Section 1
The solar energy system installed by ILI, Inc. at the Days Inn Hotel, Cagle Road, Jacksonville, Florida was fully operational June 19, 1979.

The installed system is for the production of hot water which will be supplied to the 120 unit section of the Days Inn. The hot water is for bathroom associated loads, i.e., showers, baths, shaving, etc. On the roof 960 ft² of modular collectors are mounted in steel frames. The modular collectors are copper absorber plates painted flat black, the glazing is water white glass, the absorber plate is insulated on the back. All this is packaged in an aluminum box. The collector array piping is reverse return, graded to drain all water in the collectors and piping into the 1,000 gallon storage tank when the collector circulator pump is not operating. All piping is type L hard drawn copper tubing isolated with dielectric unions at copper/galvanized interfaces. The storage tank in the mechanical room is 1,000 gallon nominal capacity. It is not a pressure vessel so it is vented through the top to the atmosphere. The tank has been sand blasted and lined with two coats of a USDA approved potable phenolic lining. The pumps are end suction centrifugal, 115 VAC, 3500 RPM open drip proof construction. The zone valves at the hot water tank are by TACO. The controls are by ILI, Inc. The 1,000 gallon tank is insulated with 3" of urethane and enclosed in a stud/sheetrock enclosure. Piping on the roof is insulated with expanded closed cell rubber and piping in the mechanical room is insulated with jacketed fiberglass insulation. During drain down two vacuum breakers admit air to speed drainage and prevent any vapor problems.

When the absorber plate of a specific collector becomes 12°F warmer than the bottom of the 1,000 gallon tank, the collector circulator pump turns on removing water from the 1,000 gallon tank to fill all the piping and collectors and begins to remove the heat from the black copper absorber plates. When the temperature difference drops to 5°F, the collector pump turns off and all piping and collectors on the roof drain back to the tank.

Currently there are 3 - 120 gallon hot water tanks that serve 120 motel units. At the bottom of each tank is a sensor continuously monitoring the temperature there. Also a on/off valve is associated with each of the three tanks. When the temperature at the top of the 1,000 gallon storage tank is 30°F greater than the temperature at the bottom of any of the 120 gallon tanks, two pumps turn on and a
valve opens for each 120 gallon tank whose bottom is 30°F cooler than the top of the 1,000 gallon tank. As the 1,000 gallon tank is non-pressurized and the domestic water lines are pressurized, a heat exchanger is used to transfer stored solar energy to the domestic hot water tanks. The first of the two pumps moves hot water from the top of the 1,000 gallon tank through the shell side of the heat exchanger where the heat is to be removed then back to the bottom of the 1,000 gallon tank. The second pump moves water from the bottom of any or all three of the 120 gallon tanks through the tube side of the heat exchanger where heat is added. The water is returned through an activated automatic valve to the top of the 120 gallon tanks. When the temperature difference decreases to 15°F, any respective zone valve will close. If all zone valves have been given the signal to close, the two pumps automatically turn off. This all occurs independent of what the solar collection system may be doing.
## Predicted System Performance

<table>
<thead>
<tr>
<th>Month</th>
<th>Building Load (MMBTU)</th>
<th>Solar Supplied (MMBTU)</th>
<th>% Solar</th>
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<tr>
<td>January</td>
<td>34.25</td>
<td>18.73</td>
<td>55</td>
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<tr>
<td>February</td>
<td>34.25</td>
<td>21.50</td>
<td>63</td>
</tr>
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<td>March</td>
<td>34.25</td>
<td>23.87</td>
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<td>April</td>
<td>34.25</td>
<td>26.30</td>
<td>77</td>
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<td>May</td>
<td>34.25</td>
<td>26.42</td>
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<td>June</td>
<td>34.25</td>
<td>24.91</td>
<td>73</td>
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<td>July</td>
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<tr>
<td>September</td>
<td>34.25</td>
<td>21.89</td>
<td>64</td>
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<tr>
<td>October</td>
<td>34.25</td>
<td>20.73</td>
<td>61</td>
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<tr>
<td>November</td>
<td>34.25</td>
<td>18.27</td>
<td>53</td>
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<tr>
<td>December</td>
<td>34.25</td>
<td>15.45</td>
<td>45</td>
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</table>
Section II
MAINTENANCE

1. MONTHLY CHECK SIGHT GLASS. When the tank is hot and the collectors are drained (end of a bright day), the water level observed in the sight glass should be below but within 1" (one inch) of the bottom of the black tape. If the level is over 1" (one inch) below the bottom of the black tape on the sight glass, water should be added. Add the water through the drain valve on the suction of the far right pump in the control box. Connect a hose between this drain valve and a spigot in the room (there are four to the left of the large tank). Open the valves at both ends of the hose and leave both open until the water level observed in the sight glass is even with the bottom of the black tape. Turn off both valves at the ends of the hose and remove the hose to prevent tampering or overfilling.

2. BI-MONTHLY CHECK AUTOMATIC VALVES. This test will determine if the valves are stuck open. Switch the bottom three small switches on the left side of the grey control box to the middle position (OFF). Wait about 1 minute. On the side of each green valve operator is a black lever. Move the lever towards the pipe and then away from the pipe - resistance should be felt moving the lever towards the pipe (you are manually opening the valve). If the lever will move only about half way and then stop - the valve is frozen shut. If no resistance is felt moving the lever - the valve is frozen open. Repeat for all three valves. Now, switch the three bottom left switches to the HAND position (push switch to the left). Wait about 2 minutes. Operating the same levers on the valves, no resistance should be felt. If resistance is felt pushing the lever towards the pipe the valve is not opening. If this condition exists see if 24VAC is being delivered to the actuator (green box on valve). If 24VAC is being delivered, replace the actuator. If 24VAC is not being delivered consult ILI, Inc. After completion of this test, return ALL the small switches to the AUTO position (far right).

3. CHECK CONTROL CARDS. If operation is questioned. Insure all switches are in AUTO position (far right). To check, the sensor at the bottom of each tank is put in ice water - the light corresponding to that sensor should turn on (if it is out); put it in boiling water - the light should turn off (if it is on). The bottom 3 of the 4 small red indicator lamps correspond to the tanks - 1, 2, 3, respectively from top to bottom.

4. PERIODICALLY RECORD TEMPERATURES. Record at least monthly. Pick a clear day and record every 2 or 3 hours. This is a record operation of the system and will help identify any problem that might otherwise go unnoticed.

5. PUMP MOTORS. The motors and pumps are permanently lubricated and require no oiling. A pump seal leaking will cause a wet spot on the floor. A burned out pump motor will illuminate one of the three lamps on the front of the control box when the pump is signaled to turn on. To turn the pumps on, first insure the breaker is on and the power switch is on. To manually turn on P-1, switch the top small switch to the far left (HAND POSITION). The small red lite below the switch should turn on along with the pump. Return the switch to the far right position AUTO POSITION). Switching any of the other three small switches to the (HAND POSITION) will operate P-2 and P-3. Return the switch to the far right (AUTO POSITION).

6. EMERGENCY TURN OFF. The switch at the top left of the grey control box will disconnect all power to the solar unit (FAR RIGHT IS OFF).
IF LEAKAGE IS THE CAUSE FOR EMERGENCY TURN OFF first close valves #5, and #6. This isolates the solar system from the city water supply and building distribution. Next close valves #1, #3, and #4. This isolates the pump can tank from the piping system. When the cause of the leak has been remedied and the valves are re-opened, valve #4 is not to be fully opened. With the power on, turn any of three bottom small switches to HAND, the turns on P-2's is 8 PSI. Return the switch to the AUTO position. All switches should now be in the AUTO or ON position.

RETURN TO OPERATION - If the system was turned off during the day, for over 15 minutes, with the sun out, the system should not be turned on until sunset. The reason for this is with the sun out and the collector plate dry, the collector plate will get very hot. If water is pumped to the collectors while they are very hot, it would flash into steam and possibly damage a collector.

To return to a safe operation put all the small switches to the middle position. Turn the power switch to ON. If the sun is not out or the system has been off for less than 15 minutes turn the top small switch to the left, the collector circulator pump should turn on. Switch the top small switch back to AUTO and leave there. One at a time, push the bottom three small switches to the left, and return to the middle position. The two other pumps should operate. After testing all three switches, push all three to the right (AUTO). The system is now in the fully automatic position.

7. PUMP FUSE CHECK.

A. S-1 must be on. Switch S-2 to HAND if the light labeled P-1 turns on then the fuse is blown; replace if required. If not, return the switch to AUTO. This tests P-1.

B. S-1 must be on. Switch S-3 to HAND if the light(s) labeled P-2 or P-3 turn on, then the fuse(s) are blown; replace if required. If not, return the switch to AUTO. This tests P-2 and P-3.
<table>
<thead>
<tr>
<th>TIME &amp; DATE</th>
<th>COLL. IN</th>
<th>COLL. OUT</th>
<th>SHELL HX IN</th>
<th>SHELL HX OUT</th>
<th>TUBES HX IN</th>
<th>TUBES HX OUT</th>
<th>COLL ΔP</th>
<th>SHELL ΔP</th>
<th>TUBES ΔP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:15 pm 6/20/79</td>
<td>138°F</td>
<td>146°F</td>
<td>145°F</td>
<td>138°F</td>
<td>130°F</td>
<td>137°F</td>
<td>16 psi</td>
<td>9 psi</td>
<td>20 psi</td>
</tr>
<tr>
<td>2:05 pm 6/20/79</td>
<td>145°F</td>
<td>153°F</td>
<td>151°F</td>
<td>143°F</td>
<td>130°F</td>
<td>141°F</td>
<td>16 psi</td>
<td>9 psi</td>
<td>20 psi</td>
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<tr>
<td>2:52 pm 6/20/79</td>
<td>147°F</td>
<td>157°F</td>
<td>151°F</td>
<td>143°F</td>
<td>130°F</td>
<td>140°F</td>
<td>16 psi</td>
<td>9 psi</td>
<td>18 psi</td>
</tr>
<tr>
<td>5:24 pm 6/20/79</td>
<td>OFF</td>
<td>143°F</td>
<td>139°F</td>
<td>132°F</td>
<td>125°F</td>
<td>132°F</td>
<td>--</td>
<td>9 psi</td>
<td>18 psi</td>
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Section III
EQUIPMENT

PUMPS
1 - BELL & GOSSETT 1535 - 3515 115VAC
2 - BELL & GOSSETT 1535 - 3525 115VAC

VALVES
3 - TACO #557 24VAC

TANK
1 - ILI, Inc. 1000 Gallon Rectangular Lined

HEAT EXCHANGER
1 - ILI, Inc. Shell and Tube 1000/1000

CONTROL CARDS
4 - ILI, Inc. SC110# Differential Controller

SENSORS
8 - HONEYWELL Sensors C773A / C773C / C773D

COLLECTORS
30 - SOLAR ENERGY PRODUCTS Collectors CU30 - WW

ILI, Inc.
5965 Peachtree Corners East
Norcross, GA 30071
(404) 449-5900
Series 1535
Uni-Built
Centrifugal Pump

A close-coupled industrial pump fabricated to exacting specifications. Featuring heavy-duty ball bearing motors. Bronze fitted construction, stainless steel shafts. For applications on cooling towers, refrigeration, industrial and general service. Available from stock—distribution points located throughout the United States.

BELL & GOSSSETT ITT
FLUID HANDLING DIVISION
Construction Materials for parts in contact with fluids pumped

<table>
<thead>
<tr>
<th>Part</th>
<th>Material</th>
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<tbody>
<tr>
<td>Volute</td>
<td>Cast Iron</td>
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<tr>
<td>Bracket</td>
<td>Cast Iron</td>
</tr>
<tr>
<td>Impeller</td>
<td>Brass</td>
</tr>
<tr>
<td>Impeller Key</td>
<td>Steel</td>
</tr>
<tr>
<td>Impeller Lock Washer</td>
<td>Steel</td>
</tr>
<tr>
<td>Impeller Lock Nut</td>
<td>Brass</td>
</tr>
<tr>
<td>Pump Shaft</td>
<td>Stainless Steel</td>
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 SEAL ASSEMBLY

<table>
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<tr>
<td>Seal Cage</td>
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<tr>
<td>Bellows</td>
<td>Synthetic Rubber</td>
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<tr>
<td>Seal Ring</td>
<td>Carbon</td>
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<tr>
<td>Spring</td>
<td>Stainless Steel</td>
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<tr>
<td>Seat Insert</td>
<td>Remite</td>
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<tr>
<td>Seat Insert Gasket</td>
<td>Synthetic Rubber</td>
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Performance Curves

Suction

Discharge

Dimensions

- Three Phase—Unit Number ending in "T", 200 Volt or 230/460, 60 Cycle, 3 Phase. (Please specify).
- All Single Phase Motors have built-in overload protectors. 3500 RPM, 175 PSI Maximum Working Pressure.

<table>
<thead>
<tr>
<th>Model No.</th>
<th>H.P.</th>
<th>Suction Size</th>
<th>Discharge Size</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
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<td>1 3/4</td>
<td>15</td>
<td>2 7/8</td>
<td>5</td>
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<td>2 7/8</td>
<td>5</td>
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<td>1 3/4</td>
<td>16 1/4</td>
<td>2 7/8</td>
<td>5</td>
<td>8</td>
<td>3/8</td>
<td>1/4</td>
<td>FIG. 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3510T</td>
<td>3</td>
<td>1 3/4</td>
<td>16 1/4</td>
<td>2 7/8</td>
<td>5</td>
<td>8</td>
<td>3/8</td>
<td>1/4</td>
<td>FIG. 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3511T</td>
<td>3</td>
<td>1 3/4</td>
<td>16 1/4</td>
<td>2 7/8</td>
<td>5</td>
<td>8</td>
<td>3/8</td>
<td>1/4</td>
<td>FIG. 2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2 HP through 5 HP units are not available in single phase.
**TACO, INC.**

1160 Cranston Street
Cranston
Rhode Island 02920

**Taco Heaters of Canada, Ltd.**
3090 Lenworth Drive
Cooksville, Ontario

---

**APPLICATION**

The Taco Zone Valve is an electrically operated valve used for zone control of Hydronic Heating and/or Cooling Systems. It controls the flow of water in a room or zone in response to the demands of the room or zone thermostat. This valve is a precisely made device and must be installed with care.

**RATING**

**Working Pressure** (PSI at Valve including Pump Head) — 125 PSI, 125 PSI, 125 PSI.

Maximum Differential Across Valve (Pump Head Feet of water) — 150 Ft, 65 Ft, 65 Ft.

Recommended Temperature Range — Max. — 240 F, 240 F, 240 F

Min. — 40 F, 40 F, 40 F

Electrical Rating

Amps. — 1.0 Max., 1.0 Max., 1.0 Max.

Volts — 24, 24, 24

---

**INSTALLATION**

Valves should be installed vertically, to simplify replacement or cleaning of the seat, if ever required at some future date. The vertical installation permits drawing a vacuum in the system and replacing or cleaning the seat without draining the system.

Valve may be sweat into the line without taking apart, provided, care is taken to prevent overheating. Follow these simple instructions: —

1. **Use a torch with sharp, pointed flame.**
2. **Clean surfaces thoroughly and use a good grade of flux.**
3. **Use 50-50 or 60-40 solder. If grades of solder requiring higher temperatures are used, such as silver solder, the valve must be dismantled.**
4. **Avoid excessive use of flux.**

**THERMOSTAT**

Use a No. 568 Taco Thermostat (designed specifically for Taco-Zone Valves) with Heat Anticipator set at “D”. Other suitable two wire (SPST) Thermostats may also be used if Heat Anticipator can be set at 0.9 Amps to match valve rating.

**TRANSFORMER**

Use a No. 569 Taco Transformer or other make rated at 115/24V-40VA. One transformer can accommodate a maximum of 3 Taco-Zone Valves.

**MANUAL OPENING LEVER**

For gravity circulation thru valve, push lever in Power Head all the way down. Push back up to restore to automatic operation. Lever moves easily when valve is open. Resistance is encountered when valve is closed.

**CAUTION:** Addition of certain chemical additives to systems utilizing Taco equipment, voids the warranty.

---

**IMPORTANT NOTE**

Never remove Power Head while thermostat is calling for heat. If necessary to remove Power Head, move thermostat to lowest setting, wait a minute, then proceed.
2 WAY MODELS

HEATING UNIT

Fig. 4

RETURN
SUPPLY

HEATING UNIT

Fig. 5

RETURN
SUPPLY

FAN COIL UNIT
(HEATING ONLY)

Fig. 6

RETURN
SUPPLY

FAN COIL UNIT
(HEATING ONLY)

Fig. 7

RETURN
SUPPLY

--- May also be used for cooling if by-pass is provided in piping to prevent chiller freeze-up.

TYPICAL WIRING DIAGRAMS

TACO THERMOSTATS

TACO THERMOSTATS

TACO ZONE VALVES
3 ZONES 40 VA TRANSFORMER

BASIC WIRING DIAGRAM
CONTINUOUSLY OPERATING PUMP

TACO ZONE VALVES
3 ZONES 40 VA TRANSFORMER

TO T. TERMINALS
ON BOILER CONTROL TRANSFORMER RELAY

BASIC WIRING DIAGRAM
INTERMITTENT OPERATING PUMP

3 WAY MODELS

HEATING UNIT

Fig. 8

RETURN
SUPPLY

FAN COIL UNIT

Fig. 9

SUPPLY
RETURN

TYPICAL BOILER HOOK-UPS

1. REDUCING VALVE
2. AIR SCOOP OR AIR CONTROL
3. FLO-CHEK
4. TACO-TROL TANK
5. CIRCULATOR OR PUMP
6. RELIEF VALVE

TO ZONE VALVES & SYSTEM

FROM SYSTEM

FOR SYSTEMS
WITH UP TO
45' PUMP HEADS

TO EXPANSION TANKS

FOR LARGER INSTALLATIONS

TO ZONE VALVES & SYSTEM

FROM SYSTEM

15
ILI 1000 GALLON TANK
THE C773 IS A PLATINUM FILM SENSOR WHICH HAS A POSITIVE TEMPERATURE COEFFICIENT. ON A RISE IN AMBIENT TEMPERATURE THE RESISTANCE OF THE SENSOR INCREASES.

- C773A contains a single sensor for storage tank or solar collector mounting.
- C773B contains a double sensor for storage tank or solar collector applications.
- C773C contains a single sensor with a flattened end and mounting hole for easy solar collector installation.
- C773D contains a double sensor with a flattened end and mounting hole for easy solar collector installation.

- Available with a medium or high ambient temperature range (specify when ordering).
- Immersion well and remote sensor wiring compartment available separately.
TRADELINE MODELS AVAILABLE:
C773A Temperature Sensor. Single sensor mounts in storage tank using immersion well or on collector with mounting clip.
C773B Temperature Sensor. Double sensor mounts in storage tank using immersion well or on collector with mounting clip.
C773C Temperature Sensor. Single sensor has flattened end with mounting hole for collector installation.
C773D Temperature Sensor. Double sensor has flattened end with mounting hole for collector installation.

LEADWIRE:
C773A,C—two black 18 inch [457.2 mm], No. 22, NEC Class 1.
C773B,D—two black, two white, 18 inch [457.2 mm], No. 22 stranded, NEC Class 1.

TEMPERATURE RANGE: Minus 50 to plus 450 F (minus 46 to plus 232 C).

TABLE 1—IMMERSION WELL TABLE

<table>
<thead>
<tr>
<th>IMMERSION LENGTH</th>
<th>INSULATION LENGTH</th>
<th>SELECT WELL MATERIAL AND ORDER NUMBER BELOW</th>
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<tr>
<td>in.</td>
<td>mm</td>
<td>COPPER 1/2 NPT</td>
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<tr>
<td>3-3/8</td>
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<td>121371A</td>
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<tr>
<td>6</td>
<td>152.4</td>
<td>122554B</td>
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</table>

*Has plastic sleeve on insertion well.

DIMENSIONS: See Figs. 2 and 3.

ACCESSORIES:
Immersion Well—for mounting sensor in storage tank. See Table 1 and Fig. 1.
Remote Sensor Wiring Compartment—for wiring storage tank sensor, Part No. 111892F.

FIG. 1—TANK SENSOR INSERTED IN IMMERSION WELL.

ORDERING INFORMATION

WHEN PURCHASING REPLACEMENT AND MODERNIZATION PRODUCTS FROM YOUR TRADELINE WHOLESALER OR YOUR DISTRIBUTOR, REFER TO THE TRADELINE CATALOG OR PRICE SHEETS FOR COMPLETE ORDERING NUMBER, OR SPECIFY—

1. Order number.
2. Accessories (immersion well remote sensor wiring compartment).

IF YOU HAVE ADDITIONAL QUESTIONS, NEED FURTHER INFORMATION, OR WOULD LIKE TO COMMENT ON OUR PRODUCTS OR SERVICES, PLEASE WRITE OR PHONE:
1. YOUR LOCAL HONEYWELL RESIDENTIAL DIVISION SALES OFFICE (CHECK WHITE PAGES OF PHONE DIRECTORY).
2. RESIDENTIAL DIVISION CUSTOMER SERVICE
HONEYWELL INC., 1886 DOUGLAS DRIVE NORTH
MINNEAPOLIS, MINNESOTA 55422 (612) 544-7800

(IN CANADA—HONEYWELL CONTROLS LIMITED, 740 ELLESMERE ROAD, SCARBOROUGH, ONTARIO M1P 2V9)
INTERNATIONAL SALES AND SERVICE OFFICES IN ALL PRINCIPAL CITIES OF THE WORLD.
INSTALLATION

CAUTION

1. Installer must be trained and experienced.
2. Disconnect power supply before connecting wiring to prevent electrical shock or equipment damage.
3. Always conduct a thorough checkout as outlined in the instructions with the primary control when installation is complete.

LOCATION

Follow the system manufacturer's recommendations for the best location of the sensor. Each sensor should be located so that it experiences the most useful temperature for proper system operation.

MOUNTING SENSOR

Mount C773A.B as a storage tank sensor using an immersion well as follows:

1. Drain system fluid to a point below the sensor fitting.
2. Screw the well into the threaded fitting. Use an approved pipe dope or Teflon tape to seal the threads.
3. Refill system and check for leaks.
4. Insert the sensor probe into the immersion well until it bottoms. See Fig 1.
5. Attach retainer clamp over groove on well spud. Fit wires in clamp groove and lightly tighten screw. Do not overtighten.

Install C773A.B as a collector sensor using the mounting clip provided and No. 8 screw. Mount C773C.D as a collector sensor using the flattened end with mounting hole and a No. 8 or 10 screw.

Temperatures in excess of 450 F [232 C] will damage the sensor. Shield the sensor against possible overtemperature conditions prior to system operation. Do not mount collector sensor to collector fluid channels.

WIRING

WARNING

1. Shield the sensor against possible overtemperature conditions prior to system operation.
2. On unglazed collectors mount the sensor with leadwires down to keep sensor from accumulating water.
3. Wire additions to the leadwires must be capable of withstanding a temperature of 460 F [232 C].

All wiring must comply with applicable codes and ordinances. The C773 can be used for numerous applications in solar energy systems. Fig. 4 shows the sensors wired to an R7412 Differential Temperature Controller.
For the C773B and C773D Temperature Sensors, the two black leadwires belong to one sensor and the two white leadwires belong to the other sensor.

If the amount of sensor cable used exceeds 100 feet (30.5 m), use No. 14 wire and grounded metallic conduit or two conductor shielded cable. Connect the shield or conduit to ground at the controller. Grounded metallic conduit or shielded cable (such as Belden 6762 or equivalent) minimizes possible radio frequency signal interference.

Remote Sensor Wiring Compartment (Part No. 111892F) is available for tank sensor wiring (see Accessories).

---

**OPERATION AND CHECKOUT**

**OPERATION**

The C773 is a platinum film sensor packaged in a copper capsule. The sensor has a positive temperature coefficient; on a rise in ambient temperature the resistance of the sensor increases (Fig. 5).

**CHECKOUT**

Make certain that each sensor is securely mounted. When observing the system in operation, check that the sensors are correctly located. Each sensor should be located so that it experiences the most useful temperature for proper system operation.

To determine the temperature which the sensor is experiencing, use a high resistance ohmmeter (20,000 ohm/volt or greater) to measure the resistance of the sensor. This measurement may be converted to a temperature reading using Fig. 5. Check a variety of temperature locations to insure that the sensor reading is providing the most accurate temperature for proper system operation.

If the sensors are not providing correct temperature readings because of location, change the location and mount properly.

---

**FIG. B—CONVERTING SENSOR RESISTANCE INTO DEGREES F [C].**
FEATURES: SUNFIRE™ CU30-WW
SOLAR COLLECTOR

- PERFORMANCE — The Sunfire™ CU30 is carefully designed and constructed of the finest quality materials to provide dependable performance with a maximum service life expectancy.
- PERFORMANCE — Our advanced design absorber plate combines copper flow tubes mechanically expanded into a highly conductive aluminum extruded wing, closed cell styrofoam insulation, high transmittance tempered glass cover plate, and a highly absorptive durable plate coating to assure outstanding thermal performance (Blue Test Analysis page 8). The CU30 may be used in open or closed systems with working pressures to 150 p.s.i. and provides thermal performance stability to 300°F. An outstanding feature of the CU30 is the advanced design of the custom aluminum extruded framework. The framework has been designed for strength and durability in mounting, in either roof-top or integrated roofing application.
- DURABILITY — The anodized aluminum frame, non-degrading tempered glass cover plate, water-resistant closed cell insulation and copper flow passages all provide for design service life of 30 years, when properly operated.
- STRUCTURAL INTEGRITY — The CU30 series collectors are designed to withstand a wind load of 130 MPH.
- EASE OF INSTALLATION — All fluid passageways are copper, compatible with standard plumbing components, practices and standard heat transfer fluids. The framework design includes a continuous flange with hinge and mounting system to provide for fast, easy installation and great flexibility in collector positioning and support.
- SERVICEABILITY — Convenient and simplified servicing can be accomplished with easy access through the front of collector.

- SEP’s Systems have been approved for use in HUD’s SOLAR
- DOMESTIC HOT WATER INITIATIVE by the Polytechnic Institute of New York and Florida Solar Energy Center.
- Independent testing has been conducted by Desert Sunfire Exposure Tests, Inc. in accordance with ASHRAE 93-77 testing standards.
- SEP’s Systems meet the testing standards set by the American National Standards Institute (ANSI B197.1-1977).
- SEP’s Sunfire™ CU30-WW solar collector has been approved by the Research Committee of IAPMO (5-1868).

LIMITED WARRANTY

The Sunfire™ CU30 Solar Collector is warranted against defects in materials and workmanship for five years from date of purchase (except for freeze damage, glass breakage and damage due to aggressive heat transfer fluid).
**SPECIFICATIONS: SUNFIRE™ CU30-WW SOLAR COLLECTOR**

**CU30-WW**

| OUTSIDE DIMENSIONS: | 98.5 x 48.5 x 2.57" |
| APERATURE AREA (sq. ft.) | 29.9 |
| CROSS FRONTAL AREA | 32.67 |
| DRY WEIGHT (lbs.) | 18.0 |

**COVER PLATE**

- **Material:** Water White glass
- **Lights Per Panel:** (1) 65.5 lbs
- **Iron Oxide Content (%)** 0.01
- **Thickness (inches):** 3.16
- **Dimensions (inches/height):** 40 x 90
- **Solar Transmission (%)** 94
- **Tensile Strength (psi):** 6400 (tempered)
- **Elastic Modulus (psi 10^6):** 10.5

**COVER PLATE GASKET:** Silicone gasket seal bonded to framework and cover plate batten, UV stable

**BACK PLATE**

- **Material:** 0.032 mill finish aluminum sheet
- **Weight:** 13.6 lbs

**FRAMEWALL, BATTEN, AND MULLION**

- **Materials:** aluminum alloy extrusion, Alloy no. 6063-15
- **Weight:** 35 lbs
- **Finish:** Clear anodized

**ABSORBER PLATE**

- **Material:** 0.01" D. 0.025 in wall copper flow tubes, mechanism expanded into extruded aluminum wings for superior thermal conductivity. Flow tubes brazed to 4" in. inch copper headers unless specified otherwise. All wetted surfaces are copper or brass.
- **Fluid Capacity:** 0.84 gallons
- **Flow Characteristics:** 0.05 ft. head at 0.75 gpm flow rate (water)

**INSULATION**

- **Material:** 1.18" thick isocyanurate foam board, routed to receive flow tube pattern
- **Thermal Conductivity:** 0.09 Btu-in. ft ^2^/hr.deg.
- **Flame Spread Classification:** 20
- **Weight:** 49 lbs

**DESIGN LIFE:** Material selection and design considerations allow an expected service life of thirty (30) years, when the panel is operated properly.

**CU30-HBM Mounting System:** Aluminum extruded mill finish hinges (4) designed to mate with any section of framework. Aluminum standoff (2) and mounting brackets (4) suitable for fixed position or adjustable mounting from 5° to 90° ±1. Weight 9.0 lbs.

**CU30-SO**

- Four 1/2" brass threaded outlets, with parallel internal 1 ID = 0.035 in wall copper headers
- Left hand and right hand 1/2" brass NPT end outlets

**CONSTRUCTION:** Copper nickerel flow tubes for aggressive heat transfer fluids.
SPECIFICATIONS: SUNFIRE™
CU30-WW SOLAR COLLECTOR

CU30-WW FLAT PLATE SOLAR COLLECTOR

Testing performed in accordance with NBSIR 76-635, ASHRAE 93-77 and ASHRAE 93-77 by Desert Sunshine Exposure Tests, Inc., Phoenix, Arizona.

APPEARANCE AREA — THERMAL PERFORMANCE CURVE

THERMAL PERFORMANCE STABILITY
Thermal distortion of the solar collector during operation and periods of stagnation to temperatures of 300°F will not cause significant deterioration of panel's performance.

SPECIFICATIONS SUMMARY: CU30
SUNFIRE™ SOLAR COLLECTOR

The CU30 Flat Plate solar collector panes shall be capable of absorbing solar radiation and transferring the resulting heat into a heat transfer fluid circulating through the panel. The absorber plate shall consist of a grid pattern of aluminum "fin" extrusions with copper flow tubes mechanically expanded into the fins, providing positive thermal contact of minimum 60% of tube surface. The enclosure box shall be constructed of clear anodized aluminum. The mounting frame extending around the entire perimeter of the panel insulation shall be 1/16" closed cell acoustovane rigid foam board. The cover plate shall be tempered water white glass with transmissivity of 94%. The panel fluid connections shall be thermally isolated 1/2" NPT brass nipple.

THERMAL PERFORMANCE
The panes' operation shall be independently tested according to ASHRAE 93-77 test standards. The panes will have a linear analysis thermal efficiency described by the equations:

\[
\text{EFF} = \frac{0.83 - 1.10(T_1 - T_2)}{1} \quad \text{(NBSIR 76-635)}
\]

\[
\text{EFF} = \frac{0.72 - 1.10(T_1 - T_2)}{Q_i} \quad \text{(ASHRAE 93-77)}
\]

DURABILITY
The pane is capable of withstanding stagnation temperatures of 300°F with significant degradation. The panel shall be designed to withstand wind loads to 130 mph, when properly mounted. The absorber plate shall be designed to allow fluid drainage for freeze protection and shall be capable of withstand working pressures of 150 psi. The panels shall have a design service life of 30 years.

SERVICEABILITY
The glass cover plate shall be removable from the front of the panel with simple hand tools. The absorber plate and other components shall then be removable through the front of the panel.

\[
T_2 = \text{ambient temperature} \\
T_1 = \frac{T_i + T_o}{2} \text{ of collector fluid} \\
Q_i = \text{Solar radiation}
\]
Solar Energy Products, Inc.
Warranty
I. SYSTEM WARRANTY
Solar Energy Products, Inc. warrants its Solar Domestic Hot Water Systems with the following conditions and limitations.

A. Conditions of System Warranty

1. This warranty is extended to consumers who purchase Solar Domestic Hot Water Systems directly from SEP or from any of SEP's Authorized Dealerships and to all subsequent owners of these systems, so long as the system remains in its original installation.

2. This warranty covers Authorized installations only when they are installed, operated and maintained according to the procedures described in the SEP Installation, Operation and Maintenance Manual and the Authorized SEP Dealer Policy Manual.

3. This warranty covers Unauthorized installations only when they are installed, operated and maintained according to the procedures described in the SEP Installation, Operation and Maintenance Manual.

4. The Warranty Registration Card for SunRaf® Energy Systems must be signed and completed by the Purchaser and the Installer and returned by the Purchaser within (10) days of the completion of each of the required Warranty Validation Inspections.

5. The Warranty Validation Inspection form must be completed by the Installer, approved by the Purchaser and returned within (10) days of completion of each of the Warranty Validation Inspections.

B. Verage of System Warranty

1. Authorized Installations

Warranty applies where the system is installed by an Authorized SEP Dealer properly licensed to install Solar Domestic Hot Water Systems.

a. One year full warranty from date of initial installation completion against failure of the Solar System, including any component or assembly where such failure is caused by a defect in materials, manufacture, installation, or corrosion of the absorber plate or coolant passages. This warranty covers the full cost of parts, labor, shipping, and handling (necessary to remedy the defect), replacement at the site (if necessary), and field inspection (within a reasonable time of the complaint to verify failure, establish probable cause, and determine corrective action by the Authorized SEP Dealer).

2. Unauthorized Installations

Warranty applies where the system is installed by a properly licensed contractor but not by an Authorized SEP Dealer.

a. One year limited warranty from date of initial installation completion against failure of the Solar System, including any component or assembly where such failure is caused by a defect in materials, manufacture, or corrosion of the absorber plate or coolant passages. This warranty covers the full cost of all parts and shipping (to the site).

3. Unwarranted Installations

Systems installed by unlicensed personnel or, those with no building permit.

II. COMPONENTS WARRANTY

Warranties the following components along with each component's manufacturer. Please refer to the manufacturer's warranty cards.

A. Collector Limited Warranty

Solar Energy Products, Inc. warrants the Solar Energy Products, Inc. Collector including any component or assembly for a period of five years from date of installation against failure of the collector caused by a defect in materials or manufacture, but not glass breakage. This warranty covers the full cost of all parts, labor, shipping (to the site), and handling (necessary to remedy the defect) replacement at the site (if necessary) and is unaffected by change of ownership as long as the collector remains in its original installation.

NOTE: Collector is not warranted against damage from exposure to freeze conditions.

B. Absorber Plate and Coolant Passages

Solar Energy Products, Inc. warrants the Solar Energy Products, Inc. Collector absorber plate and coolant passages for a period of five years, from the date of installation against failure due to corrosion in Closed Systems original fluid and any makeup consists of 50-50 mixture of Prestone® manufactured by Union Carbide Corp. or any copper compatible heat exchange fluid as determined by the Copper Development Association. and distilled water or water testing from 9.4 to 7.0 pH. In Open Systems water having a pH between 9.4 and 7.0 is acceptable. This warranty covers for the first year only, the full cost of all parts (including the cost of furnishing a new collector plate, labor, shipping (to the site), and handling (necessary to remedy the defect), and replacement at the site (if necessary). This warranty covers for the second through fifth years the full cost of all parts (including the cost of furnishing a new collector plate), labor, and shipping to the site. The warranty goes with the collector and is unaffected by change of ownership so long as the collector remains in the original installation.

C. Differential Controls Limited Warranty

Solar Energy Products, Inc., and Hawthorne Industries warrant Solar Energy Products, Inc. differential controls for a period of one year from date of purchase against failure due to defect in materials or manufacture, provided that the product has not been repaired, serviced, altered, subjected to misuse, neglect, accident or improper installation (by anyone other than the manufacturer). This warranty covers the full cost of parts, labor and shipping, and is unaffected by change of ownership so long as the controller remains in the original installation.

D. Pumps Limited Warranty

Solar Energy Products, Inc., and Grundfos Corp. warrant all Grundfos Pumps sold by Solar Energy Products, Inc. for a period of eighteen months. from date of purchase against failure caused by defect in materials or manufacture provided that they are properly installed and used with manufacturer's recommendations and have not been repaired or altered outside the Grundfos Pumps Corporation factory. This warranty covers the full cost of all parts, labor and shipping, and is unaffected by change of ownership so long as the pump remains in its original installation.

E. Storage Tanks and Storage Tanks With Built-In Heat Exchangers Limited Warranty

Solar Energy Products, Inc., and Met-Lo Industries Inc. warrant storage tanks and storage tanks with built-in heat exchangers sold by Solar Energy Products, Inc., for a period of five years from date of completion of installation against failure caused by defect in material, manufacture, or natural corrosion provided that the heat exchanger solution is maintained per instructions. This warranty covers the full cost of parts, labor and shipping and is unaffected by change in ownership so long as the storage tanks remain in their original installations.
### III. AUTHORIZED SEP DEALER

**WARRANTY REQUIREMENTS**

Authorized SEP Dealers are responsible and obligated to comply with all state and federal consumer warranty requirements.

Authorized SEP Dealers are responsible and obligated to be adequately insured for completed operations liability.

Installations must be performed by properly trained personnel in accordance with all known government building codes and practices.

Authorized SEP Dealers are responsible and obligated to perform 30 day acceptance inspection and 1 year inspection at the end of 365 days of system operation.

---

**WARRANTY SCHEDULE FOR SOLAR ENERGY PRODUCTS, INC., DOMESTIC HOT WATER SYSTEMS**

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<tr>
<th>ITEM</th>
<th>System Including Air Components and Assemblies</th>
<th>Collector</th>
<th>Absorber Plate Collector Passages</th>
<th>Differential Controls</th>
<th>Pumps</th>
<th>Storage Tank and Heat Exchanger</th>
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<td>Inspection</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Replace at Site</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>SUBSEQUENT OWNER COVERED</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

* Not warranted when damage is caused by use of unacceptable transfer fluid

---

**WARRANTOR’S NAME**

Solar Energy Products, Inc.

**ADDRESS**

1208 N W 8th Avenue, Gainesville, FL 32601

1,088 8th Avenue, Chicago, IL 60652

2555 Cline Avenue, Cleveland, OH 44108

8450 South Mars Road, Cleveland, OH 44128

7600 South Kedzie Avenue, Chicago, IL 60652

7600 South Kedzie Avenue, Chicago, IL 60652

**PHONE**

(904) 377-6527

(209) 299-0741

(216) 663-7300

(312) 434-7500

(312) 434-7500
INDEPENDENT LIVING INCORPORATED (ILI)
SOLAR ENERGY SYSTEMS
CERTIFICATE OF LIMITED WARRANTY

A FIVE YEAR WARRANTY
Each Solar Energy System which consists of the components: Solar Panels, energy storage tank, control unit, pumps, heat exchangers, and expansion vessel, is warranted by Independent Living Inc. (ILI) to be free from defects in materials and workmanship for five (5) years from the date of shipment. If found, the defective part will be replaced or replaced at ILI's option and expense. warranty issued will be returned to the nearest ILI Authorized Repair Station. The location of said repair station can be obtained by telephoning INDEPENDENT LIVING INCORPORATED Atlanta, Georgia 30341 - Tel. (404) 455-0927

B TWELVE MONTH COMPONENT WARRANTY
Each system component is warranted by ILI to be free from defects in material and workmanship for twelve (12) months from the date of shipment. If found, the defective part will be replaced or replaced at ILI's option and expense. warranty issued will be returned to the nearest ILI Authorized Repair Station. The location of said repair station can be obtained by telephoning INDEPENDENT LIVING INCORPORATED Atlanta, Georgia 30341 - Tel. (404) 455-0927

C TWELVE MONTH INSTALLATION WARRANTY
During the first twelve (12) month period following installation of the Solar Energy System, the warranty is limited to any defects in installation of the Solar Energy System. This warranty is not transferable.

D GENERAL WARRANTY CONDITIONS AND LIMITATIONS
This warranty does not cover any fluid labor for replacement or repair of parts or for inspection, maintenance, or for replacement of a component or system. The warranty period will not be extended by the warranty period. The warranty is limited to the replacement or repair of the system. The warranty is not transferable.

E LIMITATION OF WARRANTIES
It is expressly understood that this warranty is made in lieu of any and all other warranties, expressed or implied, including but not limited to those of merchantability and fitness for a particular purpose. The warranty is limited to the replacement or repair of the Solar Energy System. The warranty period shall begin to run as of the date of delivery of the Solar Energy System. Any claims against the warranty are void for any damages to the Solar Energy System. The warranty period shall begin to run from the date of delivery of the Solar Energy System.

F CONSEQUENTIAL DAMAGES
ILI shall not be liable for incidental or consequential damages and no other warranty, express or implied, is intended to be excluded or limited. The warranty is limited to the replacement or repair of the Solar Energy System. The warranty period shall begin to run as of the date of delivery of the Solar Energy System.

G GLASS
This warranty does not cover any glass damage at any time regardless of the cause.

Independent Living, Inc.
Suite 2200 Two Exchange Place, 2300 Peachford Road
Atlanta, Georgia 30341 - Tel. (404) 455-0927
<table>
<thead>
<tr>
<th>TIME &amp; DATE</th>
<th>COLL. IN #10</th>
<th>COLL. OUT #11</th>
<th>SHELL IN #12</th>
<th>SHELL HX OUT #13</th>
<th>TUBES HX IN #14</th>
<th>TUBES HX OUT #15</th>
<th>COLL. P-1 #16</th>
<th>SHELL, P-2 #17</th>
<th>TUBES, P-3 #20</th>
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</thead>
<tbody>
<tr>
<td>1:15 pm 6/20/79</td>
<td>138°F</td>
<td>146°F</td>
<td>145°F</td>
<td>138°F</td>
<td>130°F</td>
<td>137°F</td>
<td>16 psi</td>
<td>9 psi</td>
<td>20 psi</td>
</tr>
<tr>
<td>2:05 pm 6/20/79</td>
<td>145°F</td>
<td>153°F</td>
<td>151°F</td>
<td>143°F</td>
<td>130°F</td>
<td>141°F</td>
<td>16 psi</td>
<td>9 psi</td>
<td>20 psi</td>
</tr>
<tr>
<td>2:52 pm 6/20/79</td>
<td>147°F</td>
<td>157°F</td>
<td>151°F</td>
<td>143°F</td>
<td>130°F</td>
<td>140°F</td>
<td>16 psi</td>
<td>9 psi</td>
<td>18 psi</td>
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<tr>
<td>5:24 pm 6/20/79</td>
<td>OFF</td>
<td>143°F</td>
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<td>132°F</td>
<td>125°F</td>
<td>132°F</td>
<td>--</td>
<td>9 psi</td>
</tr>
<tr>
<td>2:00 pm 7/21/79</td>
<td>150°F</td>
<td>155°F</td>
<td>148°F</td>
<td>127°F</td>
<td>43°F</td>
<td>16 psi</td>
<td>10 psi</td>
<td>100 psi</td>
<td>62 psi</td>
</tr>
<tr>
<td>3:00 pm 7/21/79</td>
<td>150°F</td>
<td>155°F</td>
<td>148°F</td>
<td>127°F</td>
<td>43°F</td>
<td>0</td>
<td>8.14 in Hg</td>
<td>82 psi</td>
<td></td>
</tr>
</tbody>
</table>

---

**Notes:**
- Temperature units are in °F.
- Pressure units are in psi.
- The data includes measurements from different components of a system, likely related to a chemical or thermal process.
1. Find pump and curve
2. Find ΔP by subtracting pump suction PSI from discharge PSI
3. Read ΔP across to pump line, then down to GPM

Example: 1/2 HP, 19 PSI = ΔP = 39 GPM
Note: If vacuum on, suction is indicated
ΔP = discharge PSI + \( \frac{1}{2} \) (inches Hg.)