COOLING
1.0 GENERAL:
The U. S. Laser cooling system is a closed loop primary, open loop secondary, water-to-water heat exchanger. Temperature regulated distilled deionized water is circulated on the laser head (primary) side, while tap or chilled water flows through a stainless steel spiral plate heat exchanger on the secondary side.

Primary loop water is pumped by a close-coupled centrifugal pump which has a 3/4 H.P. motor, and a special plastic impeller and volute. In operation, the pump provides 35-50 P.S.I. of deionized water to the laser head assembly at about 4-5 gallons per minute. Unique to the U. S. Laser heat exchanger is a modulating valve temperature regulating scheme, which replaces the thermostat and solenoid valve of other laser coolers. This scheme provides greater thermal stability, and eliminates the inductive power line spikes associated with solenoid opening and closing. The system has a 5 gallon plastic reservoir and is equipped with low level interlocks. Also provided are flow rate and over temperature interlocks. All piping, fittings, and other elements exposed to water on the primary side of the heat exchanger are plastic, stainless steel, or other inert material to maintain the integrity of the deionized water.

2.0 OPERATION:

2.1 SECONDARY LOOP:

<table>
<thead>
<tr>
<th>LASER</th>
<th>MAXIMUM HEAT LOAD</th>
<th>MAXIMUM TEMPERATURE</th>
<th>MINIMUM FLOW REQUIRED</th>
</tr>
</thead>
<tbody>
<tr>
<td>303, T, 403 C, H, L</td>
<td>5 KW</td>
<td>60° F</td>
<td>3 GAL/MIN</td>
</tr>
<tr>
<td>403T, TL, CH</td>
<td>6.5 KW</td>
<td>60° F</td>
<td>4 GAL/MIN</td>
</tr>
<tr>
<td>404</td>
<td>7.5 KW</td>
<td>60° F</td>
<td>5 GAL/MIN</td>
</tr>
<tr>
<td>405</td>
<td>9 KW</td>
<td>55° F</td>
<td>4 GAL/MIN</td>
</tr>
<tr>
<td>406-1</td>
<td>14 KW</td>
<td>55° F</td>
<td>6 GAL/MIN</td>
</tr>
<tr>
<td>408-1</td>
<td>18 KW</td>
<td>50° F</td>
<td>6 GAL/MIN</td>
</tr>
</tbody>
</table>
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NOTE: CONSULT FACTORY IF ABOVE WATER REQUIREMENTS CANNOT BE MET.

External tap or chiller water is connected to the cooler by the customer via garden hose fittings on the lower rear panel of the power supply/cooler console. Inlet water is fed through the solenoid valve to the secondary side of the spiral plate heat exchanger. Water then flows through the modulating valve to the water return line. Water temperature in the reservoir is sensed by the modulating valve through a sensor in the primary water line to the reservoir. As the temperature in the reservoir changes, it is sensed by the modulating valve, which compensates by opening or closing the valve slightly, thus continuously adjusting the primary water temperature to a fixed preset level. Due to the inherent function of the modulating valve, the inlet water constantly runs at some low rate which is determined by the valve setting, the laser heat load, and the inlet water temperature. To prevent water from running when the system is not in use, a solenoid valve located in the return line is electrically controlled by the Key Switch. When the key is shut off, all water flow ceases. U. S. Laser suggests that an inline particle filter be installed on the inlet water line if the water supply will have significant particulate matter suspended in it. This will prevent potential blockage or jamming of the solenoid valve and/or modulating valve, which can lead to impaired cooling operation.

2.2 PRIMARY LOOP:
Water from the reservoir is gravity fed to the pump inlet port. The centrifugal pump then feeds water at 35-50 P.S.I., up to 6 gallons per minute (depending upon laser model), directly to the laser head through semi-rigid polyflo tubing cooling lines which are attached directly to the laser head assembly. This water cools the laser rod and laser lamp, and returns under pressure to the cooler. Attached to the body of an elbow fitting in the water supply line to the laser head are two temperature sensors. One is an over temperature warning; the other is an interlock interrupt which shuts down the laser power supply if the cooling water return temperature exceeds 120 degrees F. The return water from the laser head goes through the inline 5 micron particle filter and then through the flow switch. The flow switch is an electro-mechanical device which is tied into the main laser protective interlock loop and shuts the laser power supply down if sufficient water flow is not present. After the flow switch, the water is fed through the heat exchanger where it is cooled by the secondary water loop. After the heat
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exchanger, the water flow is split. The main flow path is a direct return to the reservoir through the sensing side of the modulating valve. A smaller flow path is fed to the deionizing filter which removes ionized material in the water in order to maintain its dielectric integrity. The deionized water then returns directly to the reservoir. The plastic reservoir tank is capable of holding 5 gallons of deionized water, and has two built in low level sensors. One sensor warns of low water level, and the other is an interlock which shuts down the laser power supply if the level falls below a critical operating point.

3.0 COOLER MAINTENANCE:

3.1 INITIAL FILLING:
As shipped, all water has been removed from the laser system. At installation, after all water connections have been made, the power supply/cooler console side cover should be removed, and the reservoir filled to within 1/2" of the top of the tank with distilled/deionized water. The cooler should then be turned on for about one minute to purge air from the laser head and coolant lines. The cooler should then be turned off, and the reservoir filled again to bring the water up to the proper level.

3.2 FILTER REPLACEMENT:
The laser system cooler is equipped with both a deionizing filter and a particle filter. During normal operation these elements should be changed every six months. The 5 micron particle filter is available from U. S. Laser as Part #3102-1 and the deionizing cartridge Part #3101. Failure to change deionizer and particle filters (they should always be changed together) could severely degrade the cooling water integrity and lead to deterioration of expensive laser head components. If the laser system is to be inactive for a substantial period of time, the cooling system should either be turned on weekly for about one half hour to circulate the water through the deionizer, or the system should be drained and the laser head dried in order to prevent water spotting of the elliptical laser head cavity.
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3.3 TEMPERATURE ADJUSTMENT:
The temperature of the primary loop water is preset and fixed at the factory, and no further adjustment should be necessary. The cooling water temperature is normally held to about 20 degrees C for Model 303, 403, 404, and 405 lasers and 26 degrees C for Model 406 and 408 lasers (± 2 degrees). If the system water temperature deviates radically from this level, the proportioning valve may be malfunctioning, and the factory should be consulted for technical assistance.