

Installation instructions for pwo coolers

1. Definition of oil/water circuit

The oil connection diameters are always bigger than the water connection diameters.

2. Where to connect the oil/water inlet and outlet to achieve counter-current flow

Oil inlet should be connected to the lower left connection (F3). Oil outlet should be connected to the upper left connection (F1). Water inlet should be connected to the upper right connection (F2). Water outlet should be connected to the lower right connection (F4).

3. Positioning of the cooler. How to install

The cooler can be mounted in any position. If there is a demand for draining any of the circuits, this has to be taken into consideration.

4. Mounting of the cooler

All units are mounted, using a clamp around the cooler. (See page 10.)

Larger units, **B35, B120, B50** are also equipped with stud-bolts as standard. These are placed on the connection side. However, the cooler should not be hanging just on these bolts.

5. How to avoid material stress in connections, caused by vibrations or pulsations

Do not mount the cooler into a rigid frame. Use Armaflex or similar to make a "soft, elastic installation". All tubing should be done in such a way that vibrations on the cooler will be at a minimum. On hydraulic systems where the cooler is connected to the return side of the system, hoses should be used.

Factors effecting fouling

Temperature, turbulence, velocity, flow distribution, surface finish and water quality all effect fouling in a cooler.

Primary causes of fouling

Laminar vs. Turbulent flow.

Laminar flow is formed when the velocity in the flow channel is uneven with low velocity next to the heat transfer surface. When the fluid passes through a tube the highest velocity will be at the centre of the tube. The fluid velocity is reduced the closer it gets to the tube wall, creating a stagnant film of low flow velocity next to the tube wall. The tube wall has no turbulence to keep particles in the fluid in motion. In laminar flow particles collect on the tube wall causing fouling of the heat transfer surface. Conventional cooler types are very sensitive to low velocities and easily get into the laminar area.

The opposite of laminar flow is turbulent flow. Operating with turbulent flows is the best way to avoid fouling in coolers. PWOs impart a high degree of turbulence to the fluid. This turbulence keeps particles moving in the fluid and actually performs a scouring action to keep the heat transfer surface clean. This is accomplished by the unique design of PWOs. As the fluid passes through the channel it is constantly changing direction, disturbing the boundary layer and insuring turbulent flow even at extremely low velocities. In ORELL Tec PWO coolers water flow rate will always be turbulent.

Cleaning

To determine whether fouling has occurred - Measuring of inlet and outlet temperatures of the cooler indicates if fouling has occurred. Fouling of the heat transfer surface decreases the heat transfer, resulting in temperature differences lower than specified.

Another way to determine fouling is by measuring pressure drop over the cooler. Since fouling restricts the passages and thus increasing the velocity, this will be shown as increased pressure drop. When using these methods make sure that the water flow rate is as specified. Changes in flow rate, of course, also effect temperature and the pressure drop.

Methods of cleaning

If cleaning of the cooler is required, back-flush with water will remove most soft deposit. If fouling appears in shape of hard deposit, circulate a weak acid through the cooler in reverse direction to the normal water flow.

Use 5% phosphoric acid or, for frequent cleaning, 5% oxalic acid or similar weak organic acid. Afterwards rinse with a large quantity of water to flush all acid from the cooler before starting up the system again. Never wait until the cooler is completely clogged before cleaning.

Filters or strainers

When there are particles in the fluid that could clog the cooler, filters or strainers should be used. Particles up to 1 mm diameter will not cause any problems. Demineralized water causes no problem. When chemically treated, please contact ORELL Tec. Sea water *cannot* be used in PWOs. For sea water applications PWOs with titanium plates are recommended. Ammonia cannot be used in PWOs.