

## Turbine Passage System

The Turbine Passage System is a hyperbaric chamber designed to create a variety of pressure regimes to simulate the pressure history that fish would experience when passing through a typical Kaplan turbine on the mid-Columbia River. The system has two 34-L exposure chambers constructed from clear acrylic pipe. Pressure within the chambers is maintained by computer-controlled hydraulic and pneumatic actuators. The system can simulate pressures at depths up to 33 meters and can quickly drop the pressure to near vapor pressure to simulate passage through a turbine runner. The computer program and hardware can also be modified to simulate fish passage conditions through other turbine designs.



Computer software, Labtech Control Program (Labtech Control Version 4.2.0 for Microsoft® Windows™, Laboratory Technologies Corporation), controls the gas cylinders used in the pressurization/depressurization sequence. Sub-programs within the Labtech Control program are used for various chamber operations. Water is pumped from the gas supersaturation system to the chambers at the desired TDG level (100, 120, or 135%), depending upon the test scenario.

### ***Water Delivery System***

Water from the gas supersaturation system flows into a trough, while a second centrifugal pump withdraws water from the trough and pumps it to the hyperbaric chambers. A valve on the outlet side of the pump is used to precisely control the quantity of water delivered. Water from the supply line is split and enters both hyperbaric chambers. Flow is equalized through the two chambers by using a restriction (round orifice) in the end of drain tubes leading from each chamber. During the acclimation period for fish, pressure within the hyperbaric chambers is set by adjusting the quantity of pressurized water delivered to the hyperbaric chambers, with back pressure determined by the size of the outlet orifice. For holding fish at 30 ft. of depth (191 kPa), a 3/32-inch orifice is used. For holding fish at the surface (101 kPa) a 3/8-inch orifice is used. Flow through each hyperbaric chamber is ~10 and ~14 L/min, respectively, and turnover rate for each chamber is 3.4 and 2.5 minutes, respectively.