SIE

COMPUTING SOLUTIONS

700 Series ATR Liquid Cooled

700 Series ATR Liquid Cooled

Features Frame Construction designed for Maximum Strength and lighter weight

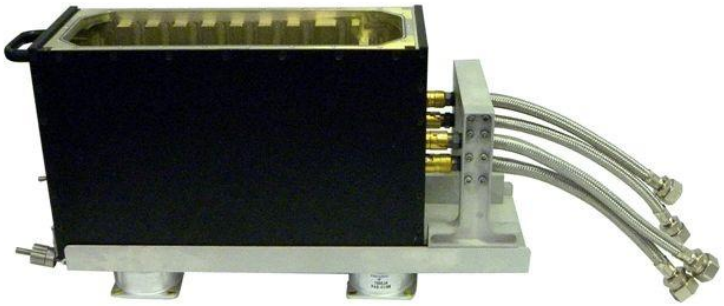
Meets the most severe shock and vibration environments

30% lighter weight than conventional ATR's

Lowest Field MTTR

Less assembly time and ease of construction

Highest versatility…All chassis sizes, use the same frame building blocks



Rear Cooling Fluid
Inlet / Outlet Points

700 Series Liquid Cooled Features

Machined side walls to accept cooler plate.

Stainless Steel (AISI 316 / 304) Vacuum brazed (CuNi) cooler plate for Salt Water.

Front or Rear cooling fluid injector points.

ARINC 404 fittings.

Optional Quick-Couple Disconnects.

Mechanical Advantages of a Dual Fluid Path System

Prevents total loss of cooling if one side wall is damaged.

Prevents total loss of cooling if the rear to side vertices are damaged.
(most vulnerable part of an ATR Chassis)

Side panels become Field Serviceable Line Replaceable Units (FS LRUs)

Thermal / Fluid Dynamics Advantages

Prevents total loss of cooling if one connector fails.

Simple LRU changes for alternate coupling devices.

Simple LRU changes for alternative cooling mediums.

Couplers may be front or rear facing, using same plates.

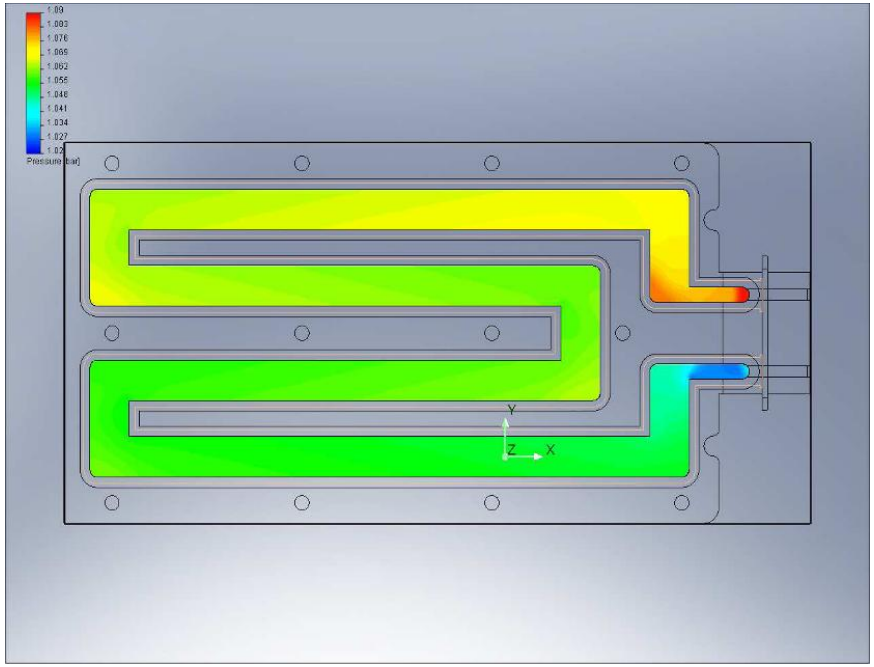
Use of Volatile Cooling Fluids

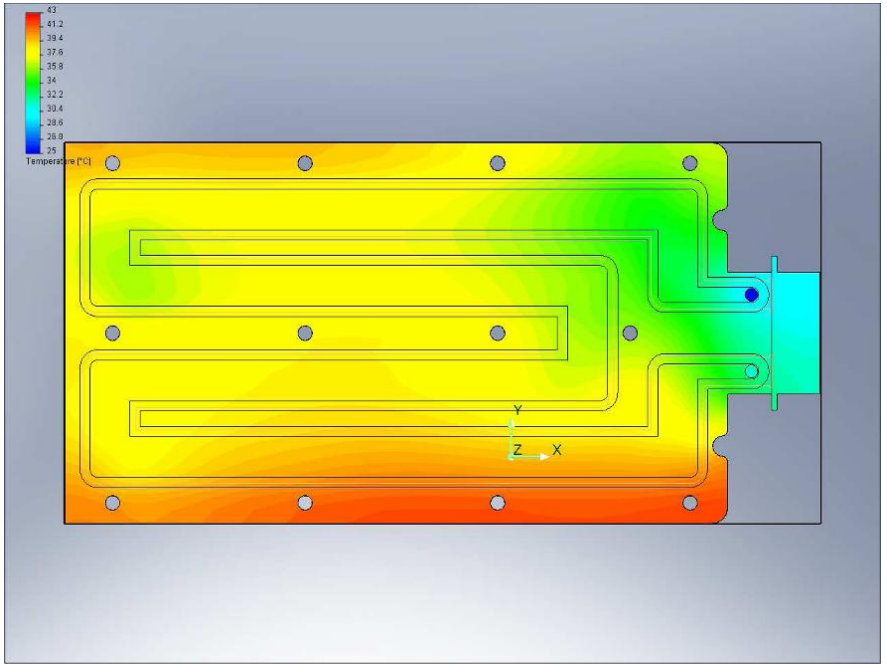
Thermal Dissipation Figures

Assuming a Maximum of 85 Degree C Thermal Interface

½ ATR-S	500W
¾ ATR-S	800W
1 ATR-S	1,000W
1 ATR-L	1,500W

700 series Liquid Cooled Side Plates





Flow : 1.2 l/min
- Pressure drop : DP = 0,07 bar

Temperature of the fluid at entrance: 25°C

Average temperature cold plate / case : 37,6 °C

700 series Liquid Cooled Side Plate

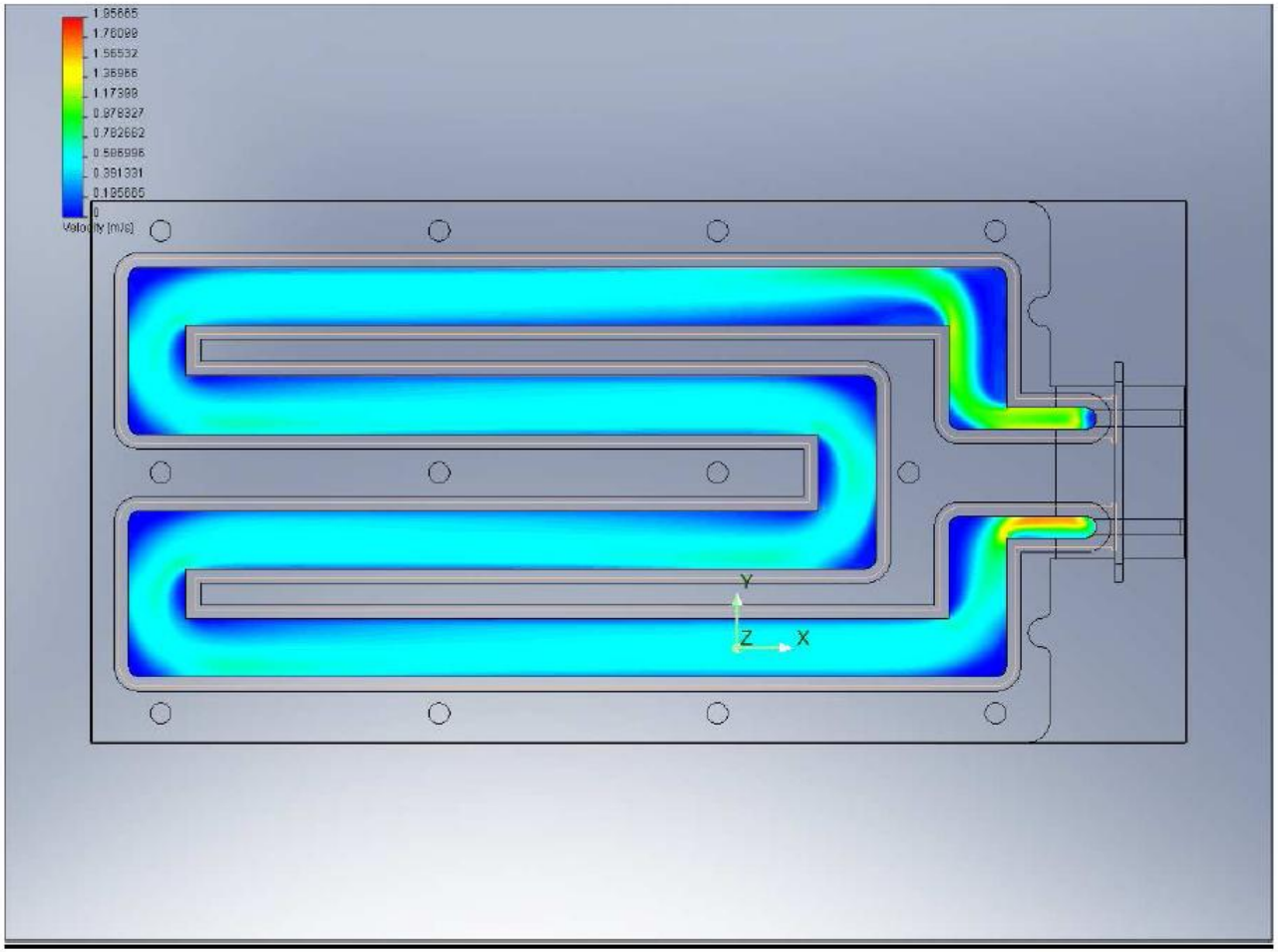
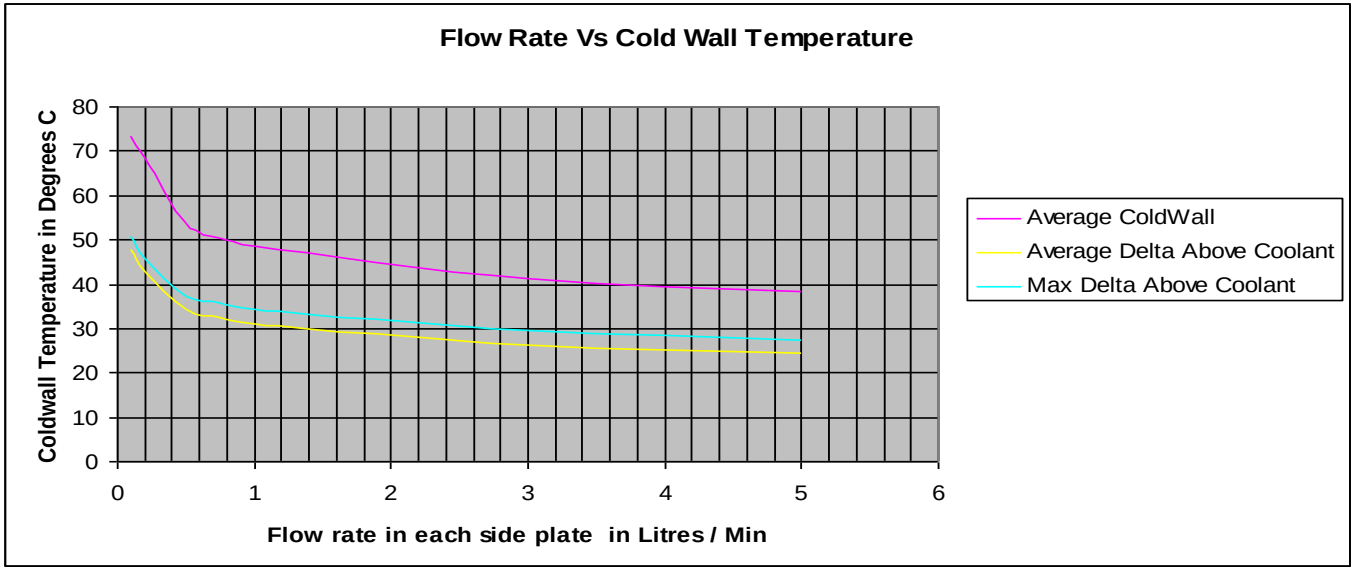


fig.3.Fluid speed in the circuit of the cold plate

700 series Cooler Plates – 1,000 Watt Load

Ambient Temperature 20 Degrees C

Flow	Average Cold Wall	Average Delta Above Coolant	Max Delta Above Coolant
0.1	73.6	47.95	50.6
0.2	68.29	42.77	45.71
0.5	53.84	34.20	37.16
0.75	50.59	32.56	35.76
1	48.68	31.12	34.42
3	41.42	26.21	29.43
5	38.52	24.48	27.46



700 series Cooling Fluids

Fluid dynamics

Sea Water :	approx +15 Degrees C
CFC's / Ammonia : PAO, Ethanol, Methanol etc	approx -32 Degrees C
Avionic Fuel (Kerosene):	approx -30 Degrees C

Selection of cooling fluid influences the choice of Plumbing, protective coatings and coupling devices.

700 series 1 ATR-Sh Liquid Cooled Thermal Testing Conclusions

Based on a thermal load of *1,000 Watts*

- Maximum increase in thermal cooling is achieved with flow rates up to approximately 1L / minute for each fluid plate.
- Increasing flow rates from 1L / minute for each fluid plate to $3M^3$ per Minute. Yields a decrease in average cold-wall temperature of 10° C.
- Increasing flow rates above 3L / minute for each fluid plate yields very little advantages in thermal cooling performance.
- As a result of the quad transverse fluid flow path there are no discernable increases in cold-wall temperature from slot 1 through to slot 10.
- At a nominal flow rate of 1L / minute for each fluid plate the average cold-wall (critical thermal interface) temperature is less than 50° C. The required maximum is 85° C.
- Tests at elevated ambient temperature show that higher ambient temperatures have a limited effect on the average cold-wall temperature.
- At 50°C ambient the average cold-wall temperature is only 3.5° C higher than at 20° C. Producing a 0.1° C average cold-wall temperature increase for every 1° C increase in ambient temperature above 20° C. For example at an ambient temperature of 70° C we would find an average cold-wall temperature of (48.7 + 7) 55.7° C
- The Average cold-wall interface responds to a change in inlet coolant temperature within 4 minutes. Showing an excellent thermal conductive path.
- Changing from a redundant dual coolant supply to a serial single supply (one inlet and 1 outlet hose with a cross coupler) yields no significant change in thermal performance.
- The enclosure self heats at a rate of 4° C per minute without any cooling applied.
- The enclosure will cool down from an elevated temperature at a rate of 1.4° C per minute.