DelCEN 2500 HV
Cooling Technology & Thermal Management details

Advanced Liquid + Forced Air Cooling:

DelCEN 2500 HV has incorporated state of the art hybrid Cooling technology. It incorporated both forced air cooling and closed loop water cooling technology. The passive components like bus bars inter connections, harmonic filter inductor and capacitors, MCBs, ACBs, PWAs etc. are forced air cooled. The IGBT switching modules are water cooled which are housed inside the IP65 inverter panel. The Harmonic Filter inductor section is housed inside IP54 Inverter panel which requires outside ambient air to cool the inductor.

Features:

- The coolant used is a mixture of Water and Glycol. Glycol is mainly used for anti-corrosion aspect and also acts as an anti-freezing agent.
- The Liquid cooling system is a closed loop system where the coolant is pre-filled in Delta factory before dispatch.
- The total Volume of the coolant is 54 liters.
- The coolant filling pressure is 2.2 to 2.4 bars, (static pressure).
- The thermal expansion tank shall be maintained at air pressure of 1.5 to 1.7bar
- Built in Continuous monitoring of pressure drop and coolant temperatures aid in protection of the inverters.
- In a rare case of gradual coolant pressure drop, there will be initial warning threshold which would require proactive maintenance (pressure push up) without any loss of generation.

Advantages:

- The Power core stack does not depend on the ambient air for the thermal performance, hence no power de-rating up to 55°C ambient is achieved.
- Also leveraging this advantage, DelCEN series provides 10% additional power over and above the nominal rating of the inverters up to 40°C ambient.
- The thermal impedance of the Aluminum to liquid is always significantly lesser than that of Aluminum to air thermal interface.
- Since the Closed loop is integrated inside the Inverter, IP65 design with efficient cooling is easily achieved compare to forced air cooling where the power stacks depends on the external air for cooling.
- The design helps to achieve maximum power density, hence making a compact foot print enabling ease of handling and low cost Installations.
- The issue of air filter clogging due to dusty outdoor environment is completely ruled out in this case especially for the IGBT power core section which forms the heart of any PV Inverter.
- The liquid cooled systems will generally be maintenance free compared to the forced air cooling in terms of dust deposits and regular cleaning required inside the air flow duct and fins of the heat sink.

Power loss table for 2.5MW inverter:

Sl. No.	Loss description	Power loss (Watts)
1	Heat loss: hot air blown out through the heat exchanger, this is basically the heat loss from the IGBT into the Coolant	26,000
2	Heat loss: dissipated through the ambient air present inside and outside the Inverter panel IP54 section	800
3	Heat loss: dissipated to the ambient air inside the inverter panel IP65 sections	1,500

Air flow details for DelCEN HV series Inverter panel:

Sl. No.	Description	Direction of Air Flow	Air Flow (m^3/h) per fan	Qty. (No's)	Total Air Flow (m^3/h)
1	Internal AC Fan Assembly, 1ϕ, 230Vac, 50Hz, IP65 section	Internal circulation, series path	331	10	3,310
2	Heat Exchanger, 3ϕ, 415Vac, 50Hz	Hot air pushed outside the Inverter panel	13,860	1	13,860
3	Fans used in IP54 sections	Outside air sucked inside from front door and pushed outside through rear door, 2 sets of 2 parallel fans series with 2 parallel fans and 2 additional parallel fans. **Air flow considered for 6 fans only.**	1,852	10	11,112
4	Air to air heat exchanger for IP65 section, 800W x 2 no's	Internal circulation	NA	2	NA

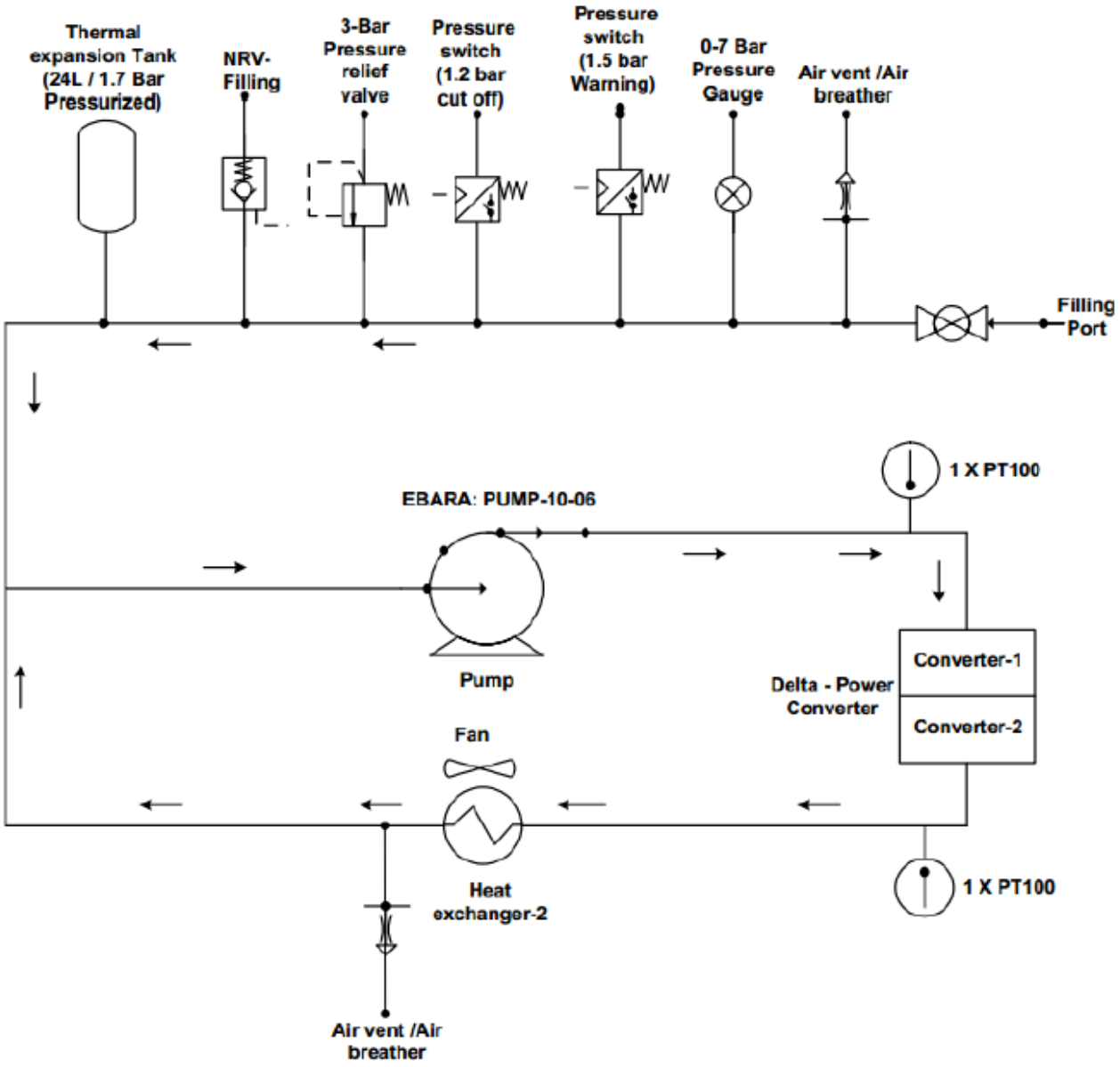
Ventilation requirements:

Sl. No.	Inverter placement Type	Clearance around the Inverter	Air Flow requirements
1	Outdoor	Minimum of 1.3m on front and rear side, Including the clearance for the bus duct pathway. Side access 1m. Need Access from all 4 sides for maintenance activities	NA
2.	RCC (Civil room / Inverter Control room)	Minimum of 1.3m on front and rear sides. 1 m for side. Need Access from all 4 sides for maintenance activities	Normal size open windows for good ventilation

Cooling System Specifications:

Sl. No.	Specification	Value
1	Flow rate	165 litres/min
2	System pressure drop	3.5 Bar
3	Dissipation to water	37 kW
4	Max. ambient temperature	50˚C
5	Max. liquid inlet temperature to stack	60.1˚C
6	Max. system static pressure	2.9 Bar
7	Input supply	415Vac/50Hz

Flow diagram:



Main components in the system:

Sl. No.	Parts	Qty. (No's)
1	Pump	1
2	Air liquid cooler/Heat exchanger	2
3	Expansion tank	1
4	Pressure relief valve	1
5	Manometer	1
6	Breather valve / Air vent	2
7	PT 100 sensor	2
8	Pressure switch	2
9	Aluminium manifold blocks	6

Description:

- This cooling system works on the principle of liquid to air heat dissipation.
- As shown in the flow diagram above, this is a closed loop cooling system with no accumulator.
- The fluid used in this cooling system is a mixture of Purified Water 70%: Glycol 30%.
- The fluid is filled in the cooling circuit using peripheral pump and maintained static pressure of 2.2 to 2.4 bar in the circuit.
- The fluid in the cooling system is circulated using a centrifugal pump.
- The fluid is circulated through the cooled plates and heat exchangers respectively with the help of centrifugal pump.
- The fluid carries the heat generated from the IGBT through cooled plate and the same heat is dissipated in heat exchangers. There is 1 heat exchanger in the system. Please refer the heat exchanger details above for information on the air flow rate and etc.
- The fluid in the circuit is cooled in the heat exchanger by dissipating the heat to the air.
- The cooled fluid is circulated back to the cooled plate to extract the heat and cycle repeats.
- We have a 24 liter thermal expansion tank in the circuit, this tank provides space for the thermal expansion of the fluid in the circuit and maintains the optimal pressure in line.
- There are 2 air vents in this cooling system and they help in releasing all the air out of the circuit.
- There are 2 temperature sensors in this cooling system, 1 temperature sensor is used to measure the inlet fluid temperature to the stacks and another temperature sensor is used to measure the outlet fluid temperature from the stacks.
- There are 2 pressure sensors in this cooling system. In case of any pressure loss, the first pressure sensor provides a warning signal at 1.5 bar. The second pressure sensor will turn off the system at 1.2 bar
- Non return valve (NRV) is provided for site filling and service purpose.

Component details:

1) Pump

Make	EBARA
Pump type (50Hz)	EVMS10 6LF5Q1BEGE/2.2
Flow rate	180 l/min
Operating temperature	-15 °C to +120 °C
Survival temperature	-20 °C to +130 °C
Protection class	IP55
No. of phases	3

2) Heat Exchanger/Cooler

Make	Parker
Heat exchanger type	Liquid to air heat dissipation
Inlet coolant temperature	63.8°C
Outlet coolant temperature	60.1°C
Ambient air temperature	50°C
Heat dissipation	37 kW
Pressure drop	0.08 (Bar)
Water flow	150 to 200 l/min
Air flow	1.5 m^3/s each
Max. fluid inlet temperature	120°C
Min. fluid inlet temperature	-10°C

3) Expansion Tank

Make	Global waters
Size	24 Liters
Preset pressure	1.7 bar
Operating temperature	-10 °C to 90 °C
Survival temperature	-10 °C to 100 °C
Connectivity	G 3/4" BSP male thread

4) Pressure Relief Valve

Make	Flamco
Working temperature	-10°C to 120°C
Survival temperature	130°C
Auto pressure relief	3 Bar
Connectivity	G 3/4" BSP female thread
Max. working pressure	10 Bar

5) Manometer

Make	Wika
Nominal dial size	63 mm
Connectivity	G 1/4" BSP male thread
Filling	Glycerine
Operating temperature	-10 °C to +80 °C

6) Breather Valve/Air Vent

Make	Flamco
Operating pressure	10 Bar
Operating temperature	-10°C to 120°C
Survival temperature	TBD
Connectivity	G 1/2" BSP male thread

7) PT100 Sensor

Make	Flui Tech
Protection Class	IP65
Operating temperature	-40°C to 180°C
Survival temperature	TBD
Plug Connection	DIN EN 175301-803 PG9
Layout	Two-Wire cable

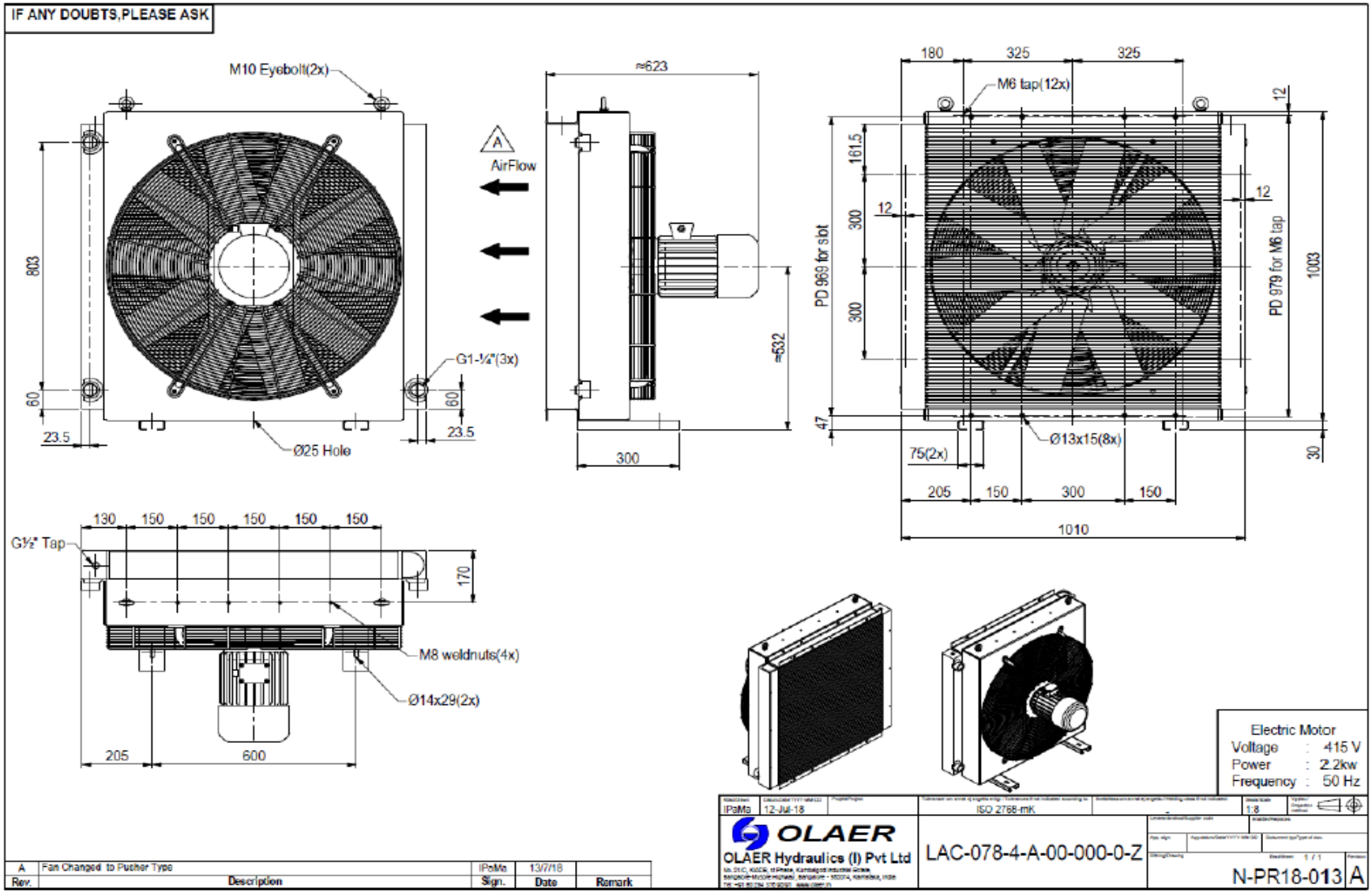
8) Pressure Switch

Make	Orion Instruments
Pressure range	0.2 - 5 Bar
Cut off set pressure	1.5 Bar
Max. Working pressure	12 Bar
Operating temperature	90°C
Survival temperature	TBD
Connectivity	G 1/4" BSP female thread

9) Aluminum Manifold Blocks

Material	Al 6061 (Anodized)

10) Heat Exchanger details



LAC 078-4-A-00-000-0-Z

(Core=95mm, Motor=2.2kw, 4 pole)

Date: 25-May-18

Our reference:

Input data:

Medium	Water Glycole
Water flow	165 l/min
Max. water temperature	63.8 °C
Air temperature	50 °C
Altitude	0.0 m
Heat dissipation	37 kW

Calculated data:

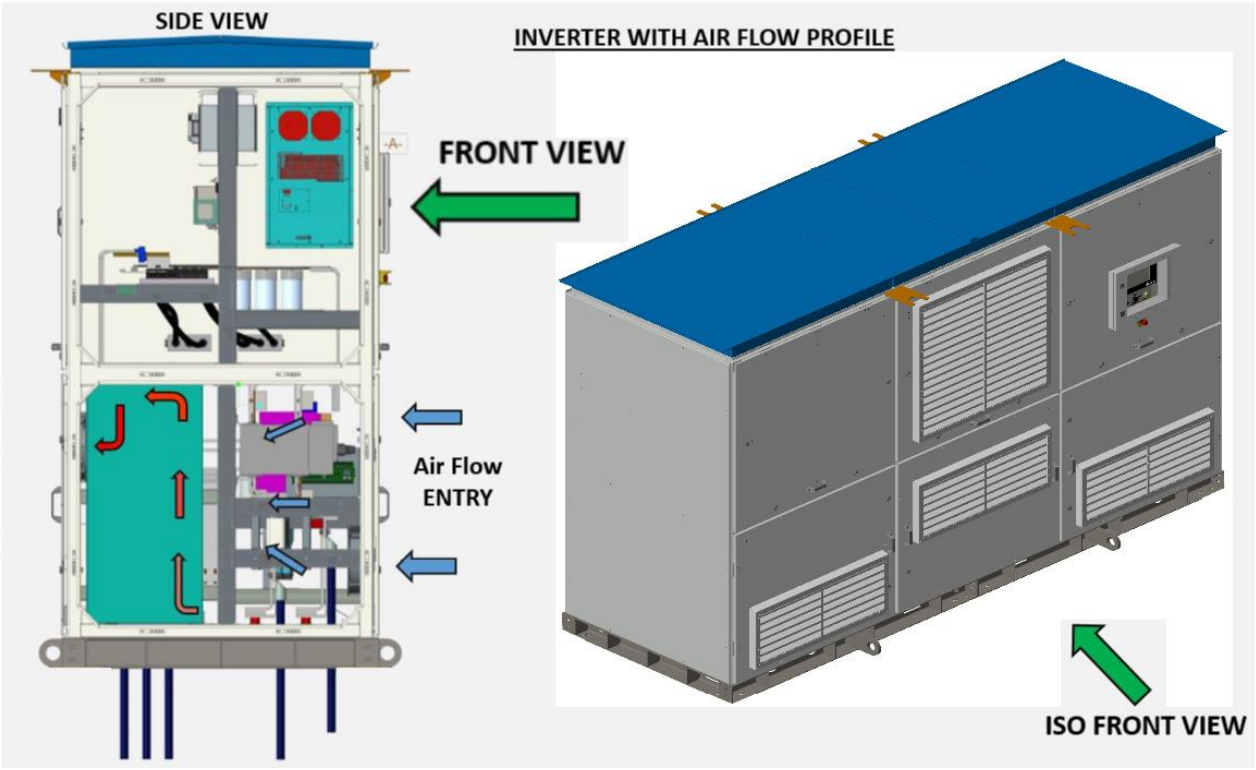
Inlet Water temperature	63.8 °C
Outlet Water temperature	60.1 °C
Outlet air temperature	59.0 °C
Spec. heat dissipation	2.68 kW/°C
Oil pressure drop	0.08 bar
Air flow	3.85 m³/s
Motor capacity	2.2 kW
LpA, 1 m	87 dB(A)
Protection standard, motor	IP 55
Weight	146 kg

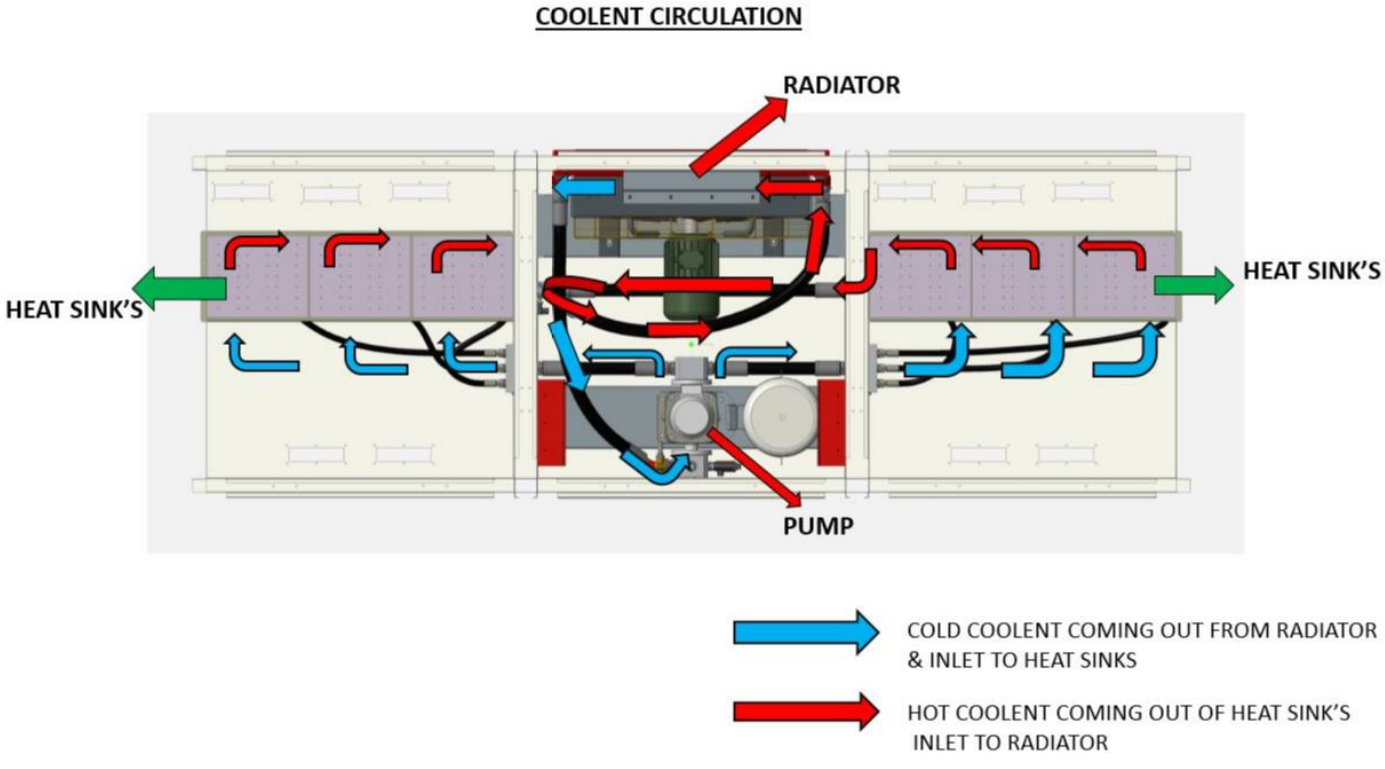
Information:

This calculation is based upon more parameters than in catalogue.

Subject to technical alterations.

Below are the Air-flow profile pictures of DelCEN 2500 HV.





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