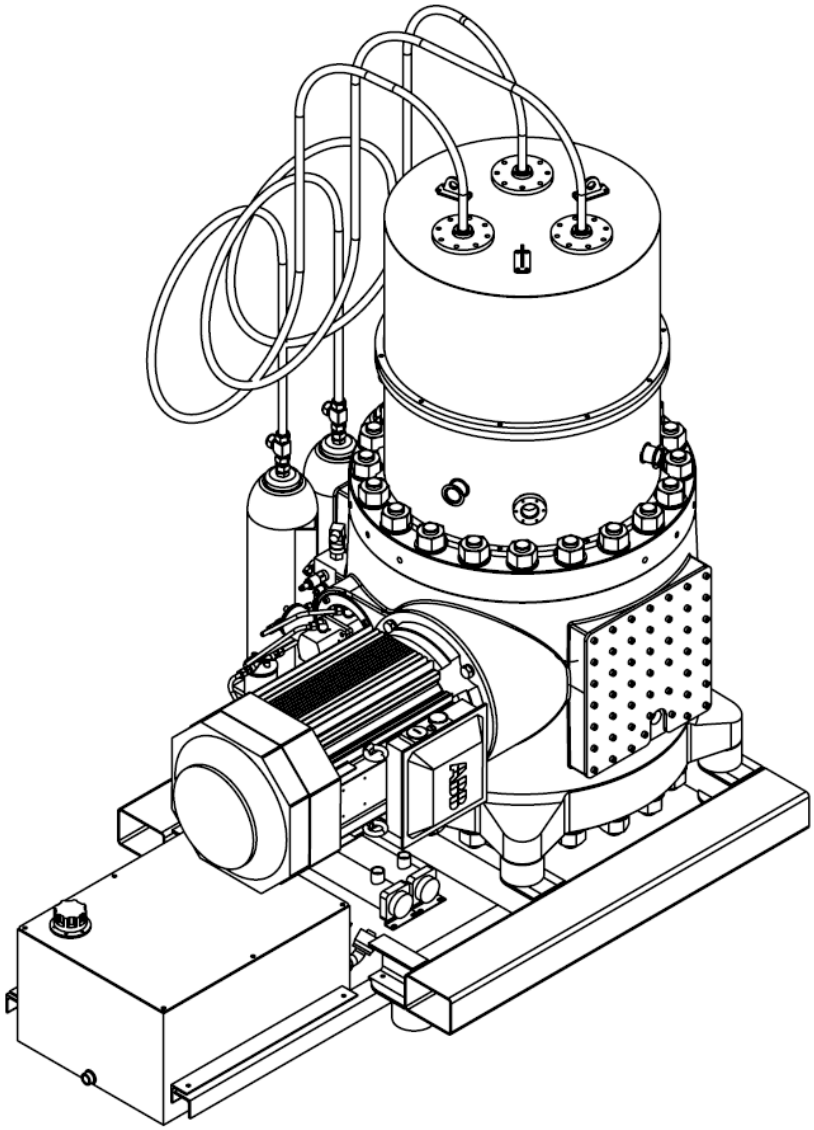
Fabrum Solutions Pulse Tube Cryocooler
Model: Evercold PTC1000
Product Description V.1.0

For safe and correct use, please read the operation manual thoroughly before operating the Cryogenic refrigerator.



Manufacturer:

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Contents

1. Technical Specification - Brief

Model	PTC1000
Swept volume	1000 cm^3
Power @ 77 K	1300 W
No load temperature	43 K
Motor Power @ 77 K	25 kW
Weight	1300 kg
Dimensions	1.8 (L) x 1.2 (W) x 2.1 (H)
Noise at 3 m	88 dBA
Frequency	50/60 Hz
Current rating	63 A

Charge Pressure	25 Bar
Pressure amplitude	5 Bar
Ambient temperature	0-35°C
Heat rejection	Water/Air
Cooling water flow rate (In water cooled configuration)	40 l/min Approx. 3 Bar ΔP
For closed loop air cooled configuration	
Coolant pump power	1.1 kW
Radiator fan power	1.4 kW

All specifications subject to change. Cooling power are given for water cooled configuration with 15°C water temperature. Dimensions and weights are for the cryocooler only.

2. Geometry and Components

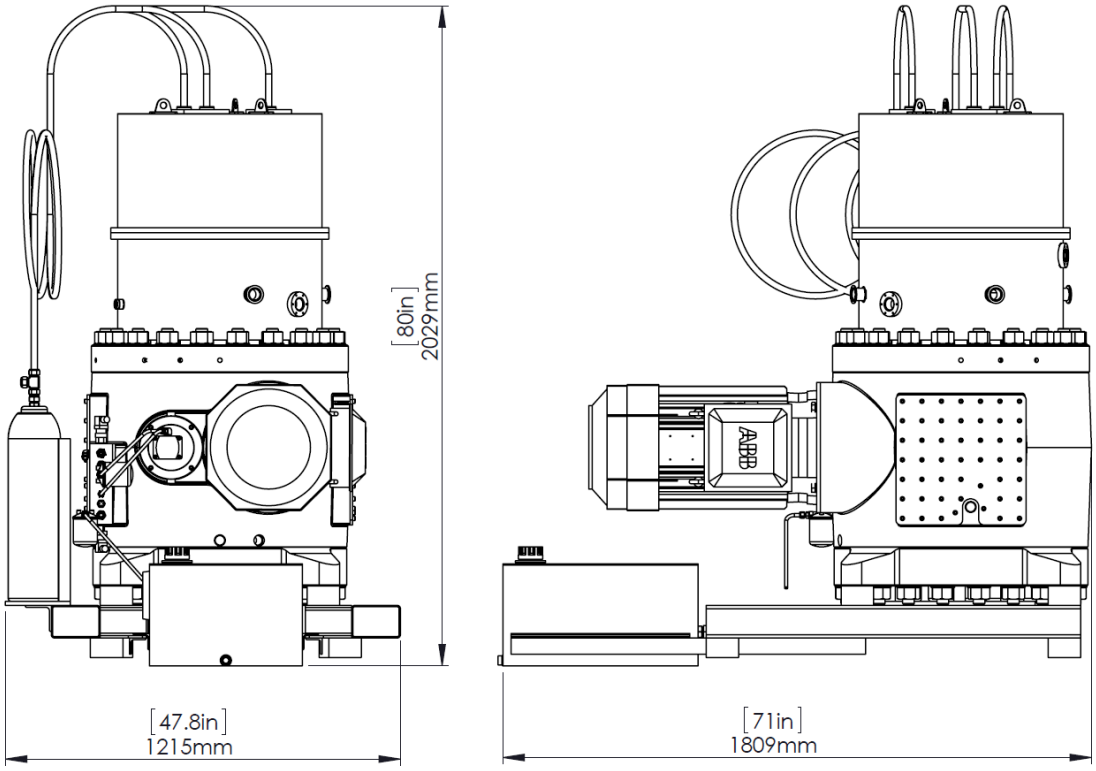


Figure 1 PTC1000 geometry

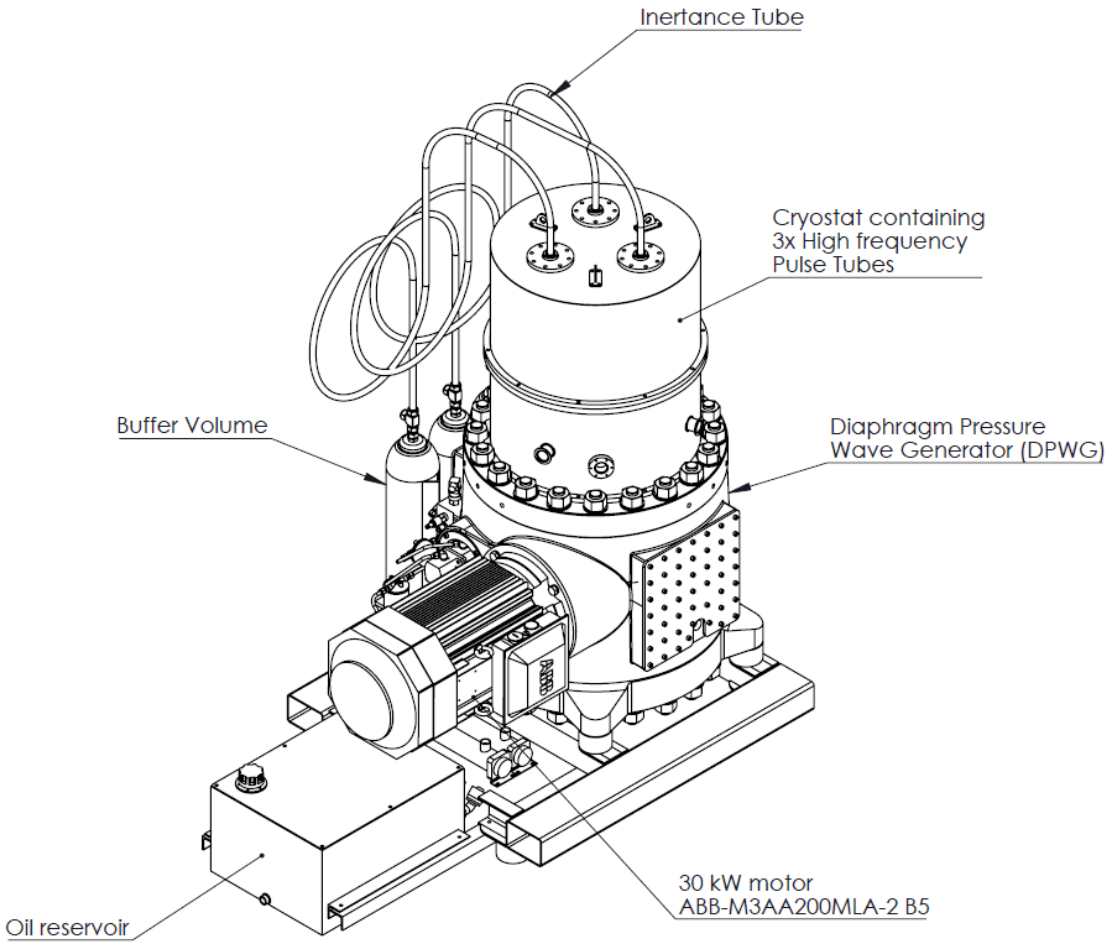


Figure 2 Component description

Proprietary Components	
30 kW Motor	ABB-M3AA200MLA-2-B5
Variable speed drive (not shown)	ACS580-01-072A-4

3. Condenser Layout

The condenser design depicted in Figure 3 has been optimised for use with a PSA feeding gas to the inlet port. In this configuration, a working dewar is used to collect the liquid, then transferred to storage and customer dewars. The condensers are within the cryostat which is under static vacuum.

All wetted surfaces are austenitic stainless steel and copper which have good compatibility with LN2, LO2 and LNG.

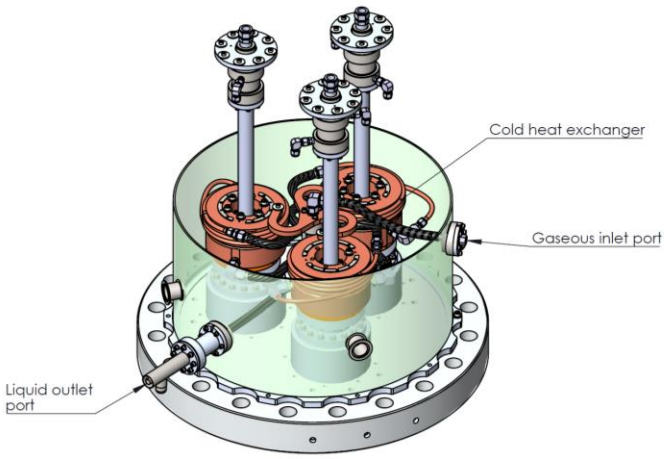


Figure 3 Condenser layout

4. Heat-lift Performance

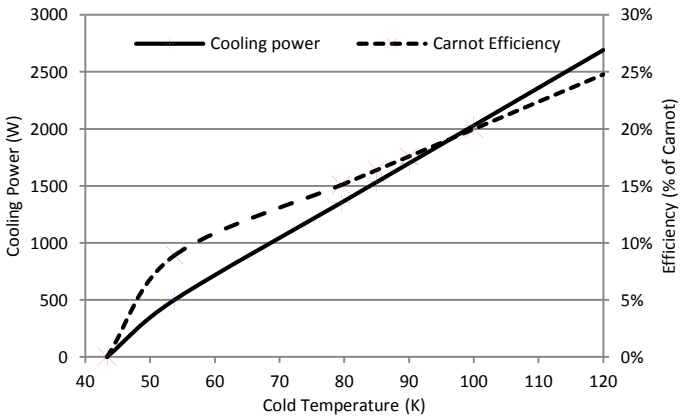


Figure 4 Cooling performance

The efficiency in Figure 4 is calculated using motor power.

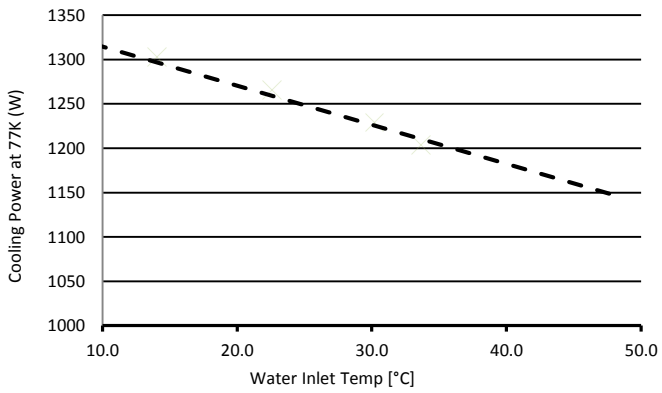


Figure 5 Coolant temperature dependence.

Figure 5 Shows the Cryocoolers derating of 4.5 W at 77 K per degree rise in cooling media temperature. This data is based on good coolant flow of 40 L/min.

5. Air Cooled Addition

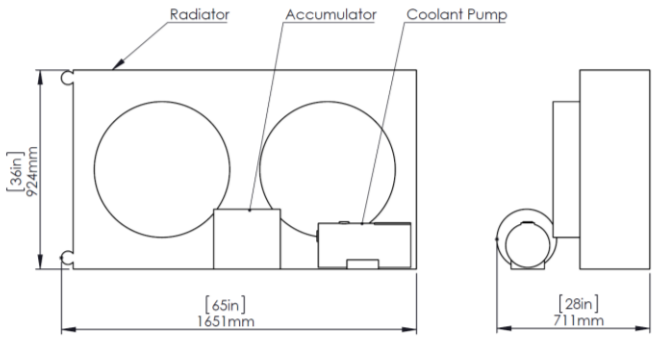


Figure 6 Air Cooling system.

Mass: 120 kg (dry)

Figure 6 shows the additional equipment required for air cooled operation. Separation from the cryocooler is trivial if required, alternately a frame can be supplied to support both the cryocooler, cooling system, controls and a dewar if required.

6. Installation Guideline

The unit must not be installed by the user. A qualified technician must install the unit.

- The unit must be mounted to an appropriate frame. Custom frames can be supplied to your specifications.
- This unit should be mounted on a level surface.
- For any bespoke applications please consult with the manufacturer.
- Direct sunlight (UV radiation) exposure should be avoided as it can damage some plastics used in this unit.
- Install only on robust concrete floor or similar.
- Every cryocooler unit is tested at the factory and carefully checked before shipment. However, independent to the checks made at the factory, the unit could be damaged during transport and therefore needs to be re-inspected.
- The unit must be installed indoors with adequate shelter.

7. Operating Guidelines

Electrical connection	
Voltage	3-phase, U_{N4}=380 to 480 V, +10%/-15%
Frequency	50/60 Hz ±5%
Power Factor	cosφ=90
Environmental limits	
Ambient temperature	0 to +35°C standard 0 to +45°C by request
Altitude	0 to 1,000 m without derating 1,000 to 4,000 m with derating of 1%/100 m
Relative humidity	5 to 95%, no condensation allowed.
Contamination levels	No conductive dust allowed

STARTUP PROCEDURE:

a. Reset the emergency stop button by twisting the knob if necessary.
b. Turn switch on Cryocooler electrical cabinet to ON.

TYPICAL OPERATING LEVELS

a. Oil level: 2/3 way up the sight gauge
b. Cooling system pressure (outflow from pump): 65PSI
c. Oil and machine temperature < 60°C.
d. Helium gas pressure - 25bar.
e. Helium gas pressure amplitude - 5 bar.
f. Running speed 48Hz.

SHUT-DOWN PROCEDURE:

a. Turn switch on liquefier electrical cabinet to OFF.

EMERGENCY SHUTDOWN PROCEDURE:

a. Press emergency stop button
b. Isolate power to the machine.

8. Fault Indication

Interlock Monitor	**Fault**
light #1	The Oil pressure is <5 bar after 15 s of running
light #2	Gas Pressure is < 5 bar
light #3	Top Plate temperature > 70°C
light #4	Machine temperature >70°C
light #5	Water pressure (pump inlet) < 5PSI
light #6	Emergency stop- pressed

9. Maintenance Schedule

All maintenance must be performed with the unit off.

Period	Work to be done	Chapter
Annually	Oil/filter Change	9.1
Annually	Visually inspect vibration isolators	9.2
Annually	Check coolant pressure	9.3
Annually	Helium gas top up	9.4
4 years (40, 000 hours)	Replacement of seals and wear components	9.5

9.1 Oil/filter Change

Drain oil from oil reservoir by removing the plug near the base. Drain into a suitable container for disposal. Re-install plug into base of reservoir ready for refill.

Fill oil reservoir through the cap on the top of the reservoir with 35 litres of Hydraulic oil. The oil level should be to the top of the level gauge on the front face of the oil reservoir.

Remove 2x spin on oil filter from the unit and replace.

Required equipment	
Hydraulic Oil	Shell Tellus 68
Spin on oil filter	BE-10-18 filter

9.2 Inspect vibration isolator

Visually inspect all 4 vibration isolators at the base of the machine. If the rubber is damaged these must be replaced.

9.3 Coolant pressure check

Note: This applies to closed loop air cooled unit only.

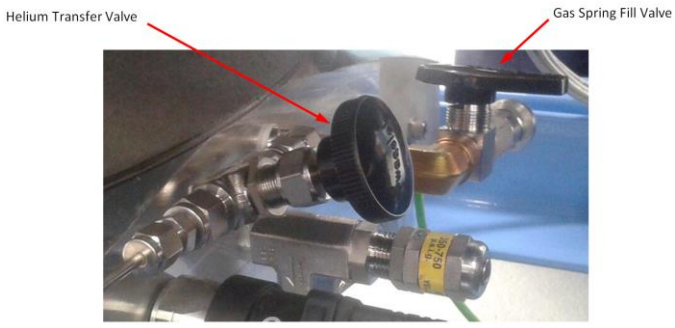
The static coolant pressure must read between 15 and 20 PSI (100 to 140 kPa). If the gauge reads outside these limits, please contact the manufacture.

9.4 Helium top up

If the running helium pressure is below 24 bar, a top up is required.

A top up can only be performed once the unit has equalized to room temperature.

Connect to Ultra High Purity Helium supply (99.999% purity) via gas spring fill valve. Ensure helium transfer valve is fully open. Fill with helium slowly to **22 bar** (approx. 1 bar/min), as the transfer line restricts helium flow between the gas spring and pulse tube. A room temperature fill to 22 bar gives 25 bar average running pressure.



9.5 Replacement of Seals and wear components

After 4 years of operation we recommend replacement of (PWG) seals, main bearings, piston seals, diaphragm, regenerator mesh (PT), and inertance tube (PT).

Safe and reliable operation of this unit is guaranteed only with Fabrum Solutions spare parts.

10. Compliance

All components within the pressure volume envelope have been designed to meet or exceed ASME VIII DIVISION 1 2013.

We are working together with a compliance consultant and Conformance UK to get CE approval for this unit. The pressure volume product is over 200 barL and therefore external certification is required. All electronics and controls are commercially available with CE marking.

11. Warranty statement

a) Full warranty on product for four (4) years of operation, from date of commissioning, subject to noted exclusions.
b) Warranty covers replacement parts in that four year period, and provision of a technician on site for first 12 months (labour and disbursements not covered post 12 months).
c) Return to base freight is covered one way if return is required.
d) Not covered for normal wear and tear as specified in the preventative maintenance schedule.
e) Not covered for over temperature operation, tampering, or misuse.
f) Safe and reliable operation of this unit is guaranteed only with Fabrum Solutions spare parts.
g) Fabrum Solutions will carry spare Pulse Tubes and at least one 'ready for dispatch' replacement part for the Diaphragm Pressure Wave Generator assembly (piston seals, bearings, cranks, master and slave piston and cylinder).