**TS-CV-DC**

**CERN**
CH-1211 Geneva 23
Switzerland

*TS/CV Detector Cooling Project Document No./MP5 No*
**127.50/FCUL-00009**

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# TECHNICAL FOLDER

## CMS TRACKER PORTABLE COOLING UNIT
## MP5: FCUL-00009


***General description and functionalities***

This portable cooling unit runs a mixture of water and ethylene glycol, cooled down by a scroll compressor refrigerating unit.
The maximum cooling power is 4.5 kW @ -25°C, corresponding to a total flow rate of 1.1 $m^3$/h, for a nominal pressure of 5 bar (~1kW @ -20°C on the distribution lines).
Three distribution lines serve the user circuits.

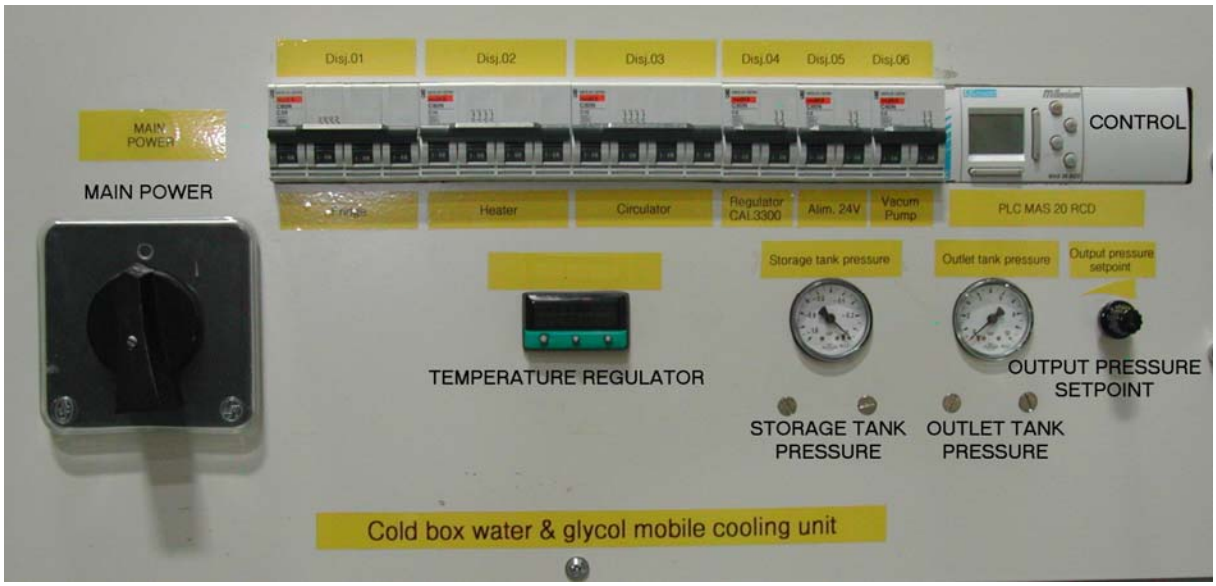
| ***Prepared by :*** | ***Checked by :*** | |
|---|---|---|
| **Stephane Berry**<br>**Florian Corbaz**<br>**Paola Tropea**<br>TS/CV<br>-<br>paola.tropea@cern.ch | | |

# 1. USER MANUAL

## 1.1 GENERAL RECOMMENDATIONS

The cooling plant shall be operated only after all the installation procedure is finished. After connecting the cooling plant to the cooling loops to be served, verify the tightness of the connections. (Put the cooling unit in Stand-by mode and let the vacuum pump stabilize the system pressures).

If big modifications have been done on the circuit, please test the system in pressure as well (1.5 times the work pressure for 24 hours).




### 1.1.1 DESCRIPTION OF THE CONTROL INTERFACE

**Main power**: switches on/off the electrical power of the cooling unit

**Temperature regulator**: it is used to set the temperature of functioning and to set-up the control parameters (PID)

**Storage tank pressure**: it gives info on the pressure measure into the tank

**Outlet tank pressure**: it gives info on the pressure measured at the distribution lines outlet form the cooling unit

**Output pressure set-point**: it acts on the pump inverter (1 turn = about 1 bar)

**Control**: it is used to switch the cooling unit between the stop/stand-by/run status, to read the alarms and to re-boot the system.

## 1.2 STARTING PROCEDURE


Before starting the cooling unit, the user must check:

- the connections to the user pipes are tight (3 valves on the distribution lines serve the three lines to the panels of the environmental chamber in bldg. 186)
- the electrical power is on
- the cooling plant is in the “OFF” mode (PLC screen)
- the correct set temperature is set on the Temperature regulator (see §5.2.1 for details)
- no alarms or warning appear on the PLC screen
- that the pump inverter (Output pressure set-point) is turned on the minimum value (turn counter clock wise until it stops)
- that the dry air flushing is activated (manual valve on the back side of the cooling rack)

N.B.: for the actual installation, some checks have to be done also on the environmental chamber:

- open the distribution circuit valves
- open the dry air distribution into the cold box (flow rate of 5 to 10 $m^3/h$)

After the checks, these steps shall be followed:

- change the PLC status in STAND-BY (push the + sign on the PLC)
- wait for about 20 minutes and check regularly that the pressure in the tank is stable at about 700 mbara (check that the “storage tank pressure” is at about -0.3)
- Open the distribution valves (if they were closed)
- Wait until the pressure is stable again
- Start the cooling plant : change the PLC status in RUN (push the + sign on the PLC)
- Raise the pressure by mean of the inverter (knob of the “outlet pressure set-point” to be turned clock wise) up to an outlet vale of 2 bar (check on the “outlet tank pressure” manometer)

### 1.2.1 SET OF THE DISTIRBUTION TEMPERATURE


To change the temperature at the distribution line:

- push the "*" on the temperature regulator
- wait for the actual temperature set point to be shown keeping the button pushed
- adjust the set-point by using the flashes (always keeping the "*" button pushed)
- Release all buttons

PLEASE NOTE THAT THE PARAMETERS OF THE REGULATOR HAVE BEEN SET FOR AN OPTIMAL USE OF THE COOLING PLANT AT -20°C. IN CASE YOU NEED BIG CHANGES IN THE DISTRIBUTION TEMPERATURE, PLEASE FORESEE AN INTERVENTION FOR THE REGULATOR PARAMETER TUNING

## 1.3 ALARM LIST & ACTIONS

| **Alarm** | **Signal generator** | **Action** |
|---|---|---|
| Low pressure on fridge unit | Pressure switch | Call for intervention (possible leak into the fridge circuit) |
| High pressure on fridge unit | Pressure sitch | Call for intervention (possible leak into the fridge circuit) |
| Low liquid level | Level meter | Check for liquid leaks, eventually fill the tank (if during the filling of the circuits) |
| Regulator alarm (T> Tset +60°C) | Regulator | Call for intervention – leave the plant in stand-by mode |
| Overheating | Thermostat du chauffage | Call for intervention – leave the plant in stand-by mode |
| High pressure in the tank | Pressure switch HP on tank | Re-start the plant in stand-by mode and verify the tightness |
| Vacuum pump : pumping time longer than 10 min | Pressure switch LP on tank | Check for leaks on the return line |
| Power failure | PLC | Run the start up procedure |

Call for intervention: Paola Tropea tel 164999

## 1.4 STOP PROCEDURE

To stop the cooling unit:

- Lower down the pump pressure (turn the "output pressure set-point" knob counter clock wise until it stops and pressure on the "outlet tank pressure" manometer is 0)
- Change the status in STAND-BY (push the - sign on the PLC)
- Change the status in STOP (push the - sign on the PLC)
- Close the distribution valves

# 2. TEST

## 2.1 PERFORMANCE TESTS IN THE LABORATORY

The parameters listed in §4.5 have been established after testing of performances in the TS/CV/DC laboratory, by Stephane Berry and Paola Tropea.

A dummy load of 6 kW has been used to evaluate the cooling unit performances.

The set point temperature for the actual parameters of the temperature regulator is -20°C. At this temperature, the cooling power of the plant is 1kW.

## 2.2 PERFORMANCE TESTS ON THE USER INSTALLATION (CMS ENVIRONMENTAL CHAMBER IN BLDG. 186 – AUGUST 04)

The three lines serving the cold box panels are connected and filled. The cold box is flushed in a continuous way by dry air. The ambient temperature varies between 20 and 28°C during the tests.

The performances of the cooling unit listed in the table below correspond to these particular ambient condition and hydraulic connection. In particular, Test A has been performed with an average ambient temperature of 26°C, and Test B has been performed with an average ambient temperature of 22 °C.

In the following tables, "T measured" corresponds to the temperature measured downstream the heat exchanger by the PT100 used as feedback signal for the electrical heater.

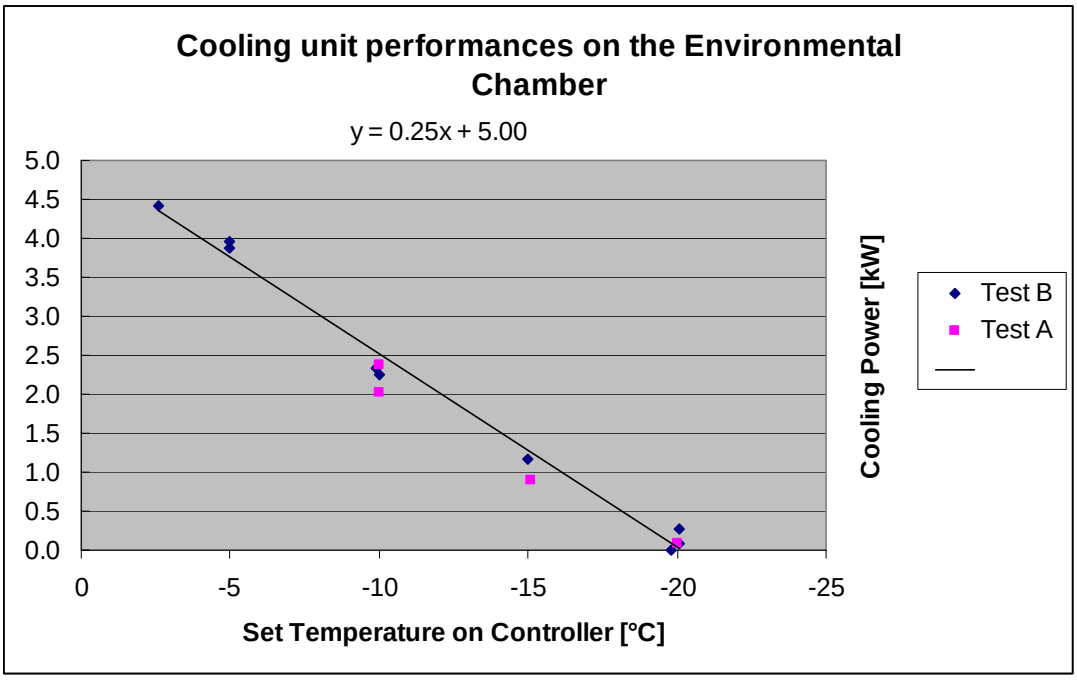
The "electrical power" corresponds to the percentage of the electrical heater which is used to maintain the set-temperature and gives the order of magnitude of the cooling power of the cooling unit which is available at that temperature for other heat than that produced by the empty environmental chamber flushed with dry air.

Table 1: TEST A

| | Cooling Plant | | | | Environmental Chamber | | |
|---|---|---|---|---|---|---|---|
| **TIME** | **T set point** | **T measured** | **El. power** | **El. power** | **T1** | **T2** | **RH** |
| **hh:mm** | **°C** | **°C** | **% of 4.5 kW** | **kW** | **°C** | **°C** | **%** |
| 10:50 | 0 | -1.6 | | | 11.8 | 9.8 | 29 |
| 14:00 | -5 | -4.9 | | | 6.8 | 4.4 | 20 |
| 17:10 | -10 | -10 | 45 | 2.0 | 2.5 | -0.1 | 20 |
| 20:00 | -15 | -15.1 | 20 | 0.9 | -2.1 | -5.1 | -- |
| 8:00 | -10 | -10 | 53 | 2.4 | 0.8 | -1.4 | 20 |
| 11:00 | -20 | -20 | 2 | 0.1 | -8.2 | -5.4 | -- |

Table 2: TEST B

| Time | Ambient | Cooling Plant | | | | Environmental Chamber | | |
|---|---|---|---|---|---|---|---|---|
| | T | T set-point | T measured | El. power | El. power | T1 | T2 | RH |
| HH:MM | °C | °C | °C | % of 4.5 kW | kW | °C | °C | % |
| 9:21 | | | 23.2 | | | 24.3 | 24.6 | 41 |
| 9:30 | | 0 | | | | | | |
| 15:35 | 23.2 | 0 | -2.6 | 98 | 4.41 | 7.6 | 5.8 | 20 |
| 15:36 | 23.2 | -5 | | | | | | |
| 8:30 | 20.1 | -5 | -5.0 | 86 | 3.87 | 4.5 | 2.5 | 20 |
| 10:10 | 20.0 | -5 | -5.0 | 88 | 3.96 | 4.4 | 2.1 | 20 |
| 10:11 | 20.0 | -10 | | | | | | |
| 12:25 | 23.0 | -10 | -9.9 | 52 | 2.34 | 1.9 | -0.9 | 20 |
| 14:30 | 24.0 | -10 | -10.0 | 50 | 2.25 | 1.6 | -1.1 | 1 |
| 14:40 | 24.0 | -15 | | | | | | |
| 18:00 | 22.0 | -15 | -15.0 | 26 | 1.17 | -2.4 | -5.4 | - |
| 18:05 | 22.0 | -20 | | | | | | |
| 19:05 | 22.0 | -20 | -19.8 | 0 | 0.00 | -4 | -7.2 | - |
| 18:55 | 23 | -20 | -20.1 | 2 | 0.09 | -5.7 | -8.9 | - |
| 8:37 | 20 | -20 | -20.1 | 6 | 0.27 | -6.7 | -9.6 | - |




## 3. MAINTENANCE

Preventive maintenance must be foreseen for some of the equipments of the cooling unit.

The table below shows an indicative maintenance procedure list:

| Equipment | Condition | Action | Spare |
|---|---|---|---|
| Pump | After 1 year | Check of the shaft seal (presse etoupe) – ev. Change | Shaft seal (to be bought) |
| Filter | After 1 year | Clean the filter | - |
| Connections | After 1 year | Check the tightness of the connections | - |