VULCATHERM

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VULCATHERM® hot/cold from type 10803 180°C or VULCATHERM® hot from type 10813 180°C/250°C and 300°C
Equipped with centralised management system

READ THIS INSTRUCTION MANUAL CAREFULLY AND FULLY BEFORE INSTALLING THE UNIT. THIS DOCUMENT IS AN INTEGRAL PART OF THE PRODUCT AND WILL ACCOMPANY IT THROUGH TO DISASSEMBLY.

EN

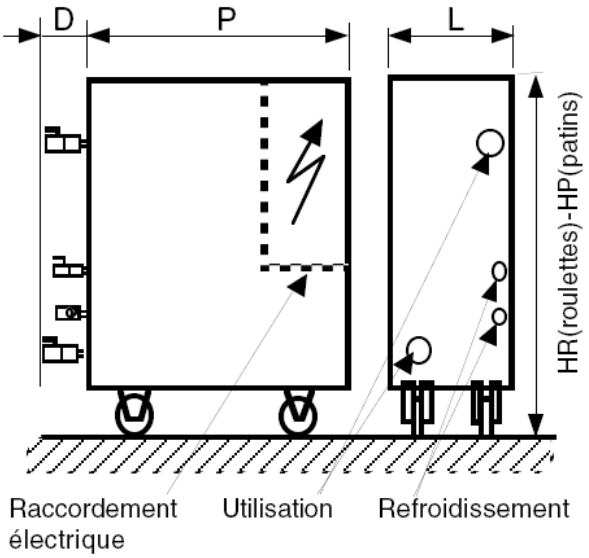
CONTENTS

1. WARNING

- Use the rating plate to check that the reference number for the commercial specification of the equipment actually corresponds to the present manual. Check also that the device frequency and the nominal voltage is the same as your electrical communication.
- Make you sure that you got the SGC manual instruction “UT30789”.
- If existing, please read in priority the annex dedicated to your Vulcatherm.

2. CHARACTERISTICS, DIMENSIONS AND HANDLING

Vulcatherm® can be handled with forklift trucks, or by slinging when it has lifting eyes.



The table given opposite provides the different standard formats.

Note:
(1) See hydraulic parts list
(2) Approximate values; depending on the option

Type (1) Format	OBSTRUCTION in mm					Mass (2) (kg)
	HR	HP	L	P	D(2)(3)	
1	570	530	300	500	150	40
2	670	630	320	550	180	50
3C(4)	780	730	400	830	200	90
3CAR(5)	980	930	400	830	200	110
5	1170	1080	500	900	280	240
5 B	1370	1280	600	1000	280	280
6	1570	1480	600	1280	300	325
6B			800		300	
6BL			800		300	
R0					180	
R0CR					180	
R0CRG(6)					180	TBD
R1					180	
R1CR					180	
R1CRG(6)					180	
R2AR	ND	2200	1000	760	300	TBD
R2CR	ND	2200	1000	1560	300	
R2CRG(6)	ND	2125	1000	2060	300	
R4AR	ND	2200	1000	1520	300	TBD
R4CR	ND	220	1000	2320	300	
R4CRG	ND	2125	1000	3000	300	1300
R6AR	ND	2200	1000	2280	300	TBD
R6CR	ND	2200	1000	3080	300	TBD
R8AR	ND	2200	1000	3040	300	TBD
R8CR	ND	2200	1000	3840	300	TBD

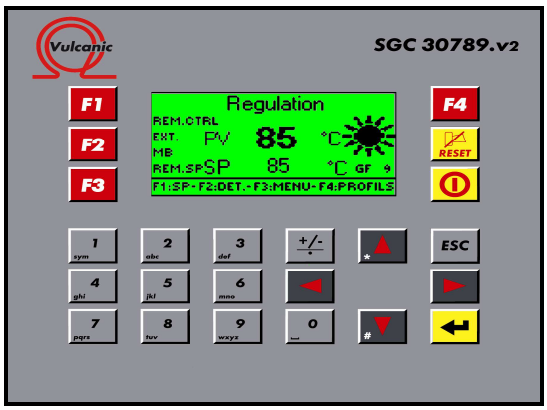
ND: option not available TBD: to be determined

3. CONTROL CONSOLE

Caution: This manual describes the operation of a Vulcatherm® with a SGC.v2 . If your Vulcatherm has a different model , please refer to the instruction manual SGC " UT30789 ."

This chapter presents the mains screens of SGCs, which are the start-up page and the elementary control. For the others screens this manual cross, refers to the instructions manual."UT30789". Moreover, in a continuous improvement approach, Vulcanic frequently updates the SGCs' software. If you observe a difference between the software available in this manual and the screens of your SGC, consult the instructions manual."UT30789".

Interface:



The interface is composed of:

- An ON/OFF key: Thermal regulator On/Off.
- A Horn Reset/Off button: to turn off the horn and reset faults.
- Keys F1 to F4 : main navigation keys.
- An alphanumeric keypad.
- A key for entering the minus sign and the decimal point.

The Four direction keys:

- The arrow: on the homepage screen, this key is only used to increase the set point. On the other screens it is used for modifying the multiple choice fields and can also be used to increase the value being input.
- The arrow: on the homepage screen, this key is only used to reduce the set point. On the other screens, it is used for modifying the multiple choice fields and can also be used to decrease the value being input.
- The arrow: this key has 2 separate functions. On the operator menu this key can be used to go to the previous page. It is an alternative to the F2 key. On the other menus, it is exclusively used to browse between fields.
- The arrow: this key has 2 separate functions. On the operator menu this key can be used to go to the next page. It is an alternative to the F1 key. On the other menus, it is exclusively used to browse between fields.
- A ESC key: allows cancelling the action in progress.
- A validate key: for recording each modification.

4. HYDRAULIC BLOCK DIAGRAM AND BILL OF MATERIALS

See attached pages in the manufacturer's file.

5. ELECTRICAL BLOCK DIAGRAM AND BILL OF MATERIAL

See attached pages in the manufacturer's file.

6. ELECTRICAL AND HYDRAULIC CONNECTIONS

- Use the rating plate to check that the reference number for the commercial specification of the equipment actually corresponds to the present manual, and that the nominal voltage is actually that for your mains supply.

6.1. Hydraulic connection

- Check the closure of the drain valves (levers removed) or drain plugs generally located at the lower points of the circuits (see hydraulic diagram) as well as the closure of any manual drain valve(s).
- Connect the device hydraulically:
  - To the receiver with 2 pipes withstanding, continuously, the maximum temperature and pressure indicated on the identification plate. The presence of a sieve filter on the operating return is not generally required, the 108x3 series Vulcatherm® being systematically fitted with a filter on the auxiliary circuit. However, in case of a first start on a receiver known to be much polluted, the temporary installation of such a filter is recommended.
  - If applicable : To the cooling circuit by 2 pipes fitted with connections suited to the device (min. pressure difference between the 2 pipes and minimum cooling water flow as per requirements of the hydraulic diagram). Check the presence of sieve filter F2 in the cold water inlet. The return pipe must withstand water at 160°C under 10 bars. It must have a minimum internal diameter complying with the Vulcatherm® tapping. The return pressure must be less than 4 bars.

IMPORTANT: THE COLD WATER SUPPLY NETWORKS MUST BE FREE OF PARTICLES GREATER THAN 100 µm.

When several Vulcatherms® have been connected in parallel on the same cooling circuit, the piping must be balanced to avoid preferential passages, which could generate regulation instabilities. It is therefore recommended to oversize the diameter of the evacuation pipes and to install a water-hammer arrester expansion vessel on the inlet header.

- If the receiver has lower points located below the Vulcatherm®, a tap have to be installed there to ensure the possible full draining of the circuit.

CAUTION: The hydraulic connections for external use of this device are brought to the maximum temperature indicated on the identification plate and restated in paragraph 1. Prevent risks of burns to the personnel through suitable protection at the time of installation (thermal insulation, cover...).

6.2. Electrical connection

- Connect the electrical power cable to the electricity mains (inside the electrical cabinet, on the upstream side of the internal circuit breaker Q).

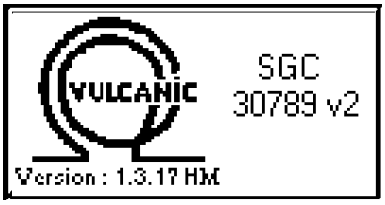
DANGER:

This connection must be carried out according to good engineering practices and applicable regulations, particularly for the cable diameter used. The power supply line must be able to withstand, in steady state, the maximum current shown on the electrical diagram and the identification plate. It shall be properly protected upstream, with distributed earthing.

- Connect the connection cables between the Vulcatherm® and the remote automatic controller (options on terminal block, see electrical diagram).
- After having checked that there is an appropriate voltage on the power supply terminals, close the door of the electrical cabinet.
- Check that the emergency stop button is actually released then close the general circuit breaker Q.

6.3. Energising

- The first page after switching on the machine displays the software version, this is greater than or equal to version 1.3…
- After 10 seconds (corresponding to the microprocessor functional self-test), the buzzer sounds, press the "STOP KLAXON / RESET" RESET key, the home page is then displayed.



7. COMISSIONING PROCEDURE

7.1. Filling the circuit

- Remove the side access panels from the hydraulic part.
- Check that the isolation valves allowing circulation in the operating circuit are opened.
- Open the isolating valve of the cooling water circuit.

IF THERE IS A COLD WATER RETURN VALVE IT MUST BE NEVER CLOSED, including when Vulcatherm® is used exclusively for the heating function.

- Open the manual filling valve PM and manually fill tank AC with thermal fluid, up to its maximum level (overflow orifice). This operation provides pre-filling of the receiver circuit. Certain high pressure pumps also have a degassing screw in the upper part, it is then necessary to loosen for a few moments (with the pump stopped) until the air is completely removed.

CAUTION

The use of a thermal fluid of quality and ISO viscosity at 40°C complying with those for which the Vulcatherm® was pre-set and factory tested is indispensable, on penalty of displaying erroneous values when using the flow rate indicator.

- Then tighten the vent valve screw PM.
- Check that the emergency stop button is actually released then close the general circuit breaker Q.

7.2. First configuration of operating parameters

(Have the parameter setting log, APPENDIX 1.1 of the manufacturer's file, to hand.)

Before first commissioning it is necessary to check in the S.G.C.v2 "Adjuster" menu (menu reserved for qualified personnel), that the programmed parameters allow local mode control of the Vulcatherm®.
To do this:

- Press the operating modes and menus F3 button & then the settings F1 key.
- Then press F1 key (Adjuster menu).
- Scroll through all the "Adjuster menu" parameters using the F1 keys and configure them (see chapter 11.1 and chapter 2.2), these are digital values and parameters cycled in a loop.
- Some "pages" are only accessible if the option has been programmed into the “Vulcanic menu”.

7.3. Degassing the circuit

- Select the "PUMP ONLY" operating mode (see chapter 10.3.1).
- Locate the arrow confirming the correct direction of the pump drive motor's rotation.
- Check the pump rotation direction by short duration starts / stops. If necessary, invert the order of 2 phases on the main power supply.
- Deliberate throttling of the isolating valve on the usage outlet can accelerate the degassing process in the case where too much air was introduced, provided, however, that the flow does not fall below the minimum flow threshold, triggering a fault.
- Then let the pump run for sufficient time to complete filling of the receiver and the connection pipes. Several successive starts are necessary to prime the pump. When the flow rate is less than the minimum contractual value, the "LOW FLOW RATE" message appears, then if the fault persists for about 30 seconds, the buzzer sounds and the pump stops. Press the "STOP KLAXON/RESET" 

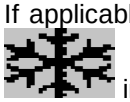
button so allowing the pump to restart. To encourage degassing of the circuit, it is advisable to wait about 1 minute after each stop. Observe the air bubbles rising in the transparent tube placed on the side of the tank, a sign of degassing.
- Maintain the high level in the tank by successive additions of thermal fluid up to the overflow outlet, in order to avoid the triggering of the low level contact NB and the appearance of a fault.

  THE PUMP MUST BE NEVER OPERATED DRY.
  Consequently the fluid in the tank must fall below the visible level.

- Complete degassing of the circuit is generally only possible on the first temperature rise, which improves the decanting of air bubbles by reducing the heat transfer fluid viscosity.
- Return to "REGULATION" mode (see chapter 11.3.1)

7.4. First heating

On the home page

- Set the temperature setting at the value of 120°C.
- Switch on the Vulcatherm® by pressing the "STOP/START" key. If the flow rate is insufficient, the "LOW FLOW RATE" message appears, then, if the fault persists for about 30 seconds, the buzzer sounds and the pump stops. Press the "STOP KLAXON/RESET" button so allowing the pump to restart.
- Several stops are necessary to allow the air pushed towards the pump inlet to escape through the automatic degasser PA. Observe the air bubbles rising in the transparent tube placed on the side of the tank. Restart the pump when the air eliminator PA no longer releases gas bubbles.
- When the circuit is full and purged of its air (stable level in the tank and absence of air bubbles rising in the transparent tube), fully open the valve R1 located on the operating circuit outlet.
- If applicable, test cooling operation. Then select the "FORCED COOLING" mode. The  indicator then appears. The actual circulation is checked by disconnecting the outlet pipe (when the pressure and temperature conditions allow this), or by fitting an in line flow meter on the cold water inlet.

The cooling effect can only be quickly checked on the temperature measurement ("PV" on the home page) when the cooling water is markedly colder than the measurement.

- Then adjust the level in the tank, *when the heat transfer circuit fluid temperature is close to ambient (about 30°C)*, by draining the surplus fluid through the plug or "filling limit" valve R5 so as to leave the expansion volume free.
- Vulcatherm® is now ready to regulate the heating and cooling.

7.5. Testing the regulation and display functions

On the home page

- Set the temperature setting to the desired value, within the high and low temperature limits for the fluid outlet.
- Switch on the Vulcatherm® by pressing the STOP/START button. The regulator heating and cooling commands are displayed on the home page. The correct operation of the temperature regulation can now be checked.
- Display menu U2 "Vulcatherm® Details " (see chapter 10.4) The numerical value of the hydraulic outlet pressure appears opposite the “pressure” indicator. Check that this pressure is still less than the sum of the static pressure (read when the pump is not running) and the max. total manometric height of the pump (TMH max. defined in paragraph 1), however without exceeding 10 bar.

This maximum pressure is visible when the outlet valve is completely closed.

THE OUTLET VALVE MUST NOT BE CLOSED FOR MORE THAN A FEW SECONDS.

Still in the same menu check that the flow rate is close to the contractual value (see paragraph 1).

- Stop the Vulcatherm® by pressing the "STOP START " key after all the above operations have been satisfactorily accomplished, then loosen the manual filling vent PM for a few seconds until the air accumulated at the high point or the equipment has been completely purged, taking the necessary precautions to prevent risks of burns to personnel.
- Vulcatherm® can then be used in accordance with its definitive operating conditions.
- Before closing the side doors check by hand that the stabilised tank temperature does not exceed 70°C, including and above all when the thermal fluid control is done at the maximum of the setting scale.

IMPORTANT NOTES

- The receiver must be perfectly sealed (particularly if its high point is located above Vulcatherm®), in order to avoid overflowing of the tank after stopping of the pump (by the connected vessels phenomenon).
- The receivers run through at low speed by the thermal fluid (tanks, double casings...) must be fitted with a degasser at their high point. This degasser can be of "automatic" type only if Vulcatherm® is installed above the receiver.
- In the absence of degassing, air pockets, compressed by the pump pressure, would push back thermal fluid towards the tank after the stopping of the pump.
- Generally, the degassers are not indispensable at the high points of the receivers run through at high speed by the heating fluid (coils, exchangers, channels within the tooling...). In contrast they are essential on the pipes between the receiver and Vulcatherm®, when they are very long and have a high point.
- When the boiling point of the water contained in the cooler is exceeded (which varies depending on the pressure in the evacuation pipes), Vulcatherm® will show a reduction in the rate of temperature increase.
  Furthermore, if traces of humidity persist in the oil circuit the boiling of this moisture will be shown by small jets of steam and the high points fitted with degasser, as possibly by overflowing of the tank.
  It will then be useful to maintain the regulation setting (on the oil outlet) slightly below this temperature (which depends on the pressure loss in the receiver), during the team needed for definitive drying of the oil charge. A flexible pipe can be connected to the overflow outlet to guide the overflows.
  NEVER OBSTRUCT THE OVERFLOW OUTLET.
- If the pump generates an abnormal noise during heating or if the pressure and the flow are not stable, continue the degassing operation at minimum flow rate as described at the start of the paragraph.

DANGER

The screw on the manual filling valve vent PM must never be open when the heat transfer fluid outlet temperature is greater than 50°C !

8. STARTING PROCESS IN REGULAR USE

- If Vulcatherm® has not been hydraulically or electrically disconnected it is sufficient to press the "START/STOP" button located on the S.G.C front panel.
- If Vulcatherm® has been disconnected or if the receiver is leaking the heat transfer circuit can have stored a little air. apply paragraph 7.
- Deliberate throttling of the isolating valve on the usage outlet can accelerate the degassing process in the case where too much air was introduced, provided, however, that the flow does not fall below the minimum flow threshold, triggering a fault.

  Readjust the level in the tank as needed, but without exceeding the filling limit.

  CAUTION:

  An automatic degasser placed above the Vulcatherm® causes continuous air entry when stopped. It is thus indispensable that the purge units installed on the receiver are manual valves with swan neck.
- The flow rate can be checked in the "Vulcatherm® Details" menu (see chapter 10.4).
- The value displayed by the indicator was verified in the factory at the nominal flow rate and the mean temperature of 160°C (10/180°C scale). The accuracy of the indicator obviously degrades at low temperatures and low flow rates.

9. DRAINING

It is always possible to drain a part of the heating circuit, in order to limit the loss of fluid during the disassembly of the connecting pipes.
Stop the device, after having checked that the heating fluid is at a temperature lower than 50°C.
Otherwise, use beforehand forced cooling or lowers the regulation set point.
Close the cooling water inlet valves.
Carefully open the drain tap or plug of the speed-breaking bottle, after having eventually connected therein an evacuation pipe to the tap of the retention tray.

DANGER:
NEVER OPERATE WHEN THE PUMP IS FLAT BROKE

- The valve or drain plug located on the inlet pipe (and any pump drain plug) allow recovery of the rest of the heat transfer fluid in the Vulcatherm® by gravity. Also open the drain valve located at the low point of the receiver circuit, if there is one.
- Close all the drain orifices, and remove any operating levers to limit the risk of accidents during operation.

CAUTION: Do not store the equipment where there is a risk of frost without previously fully draining the cooling circuit (low points, filter bodies).

10. DESCRIPTION OF THE SGC FUNCTIONS

This chapter presents the Sgc screens that are essential for the start-up, and for basic control of the Vulcatherm®. For the other screens, this manual cross refers to manual “UT30789”.
The Centralised Management System functions can be put into 2 categories:

- The main functions including heating fluid temperature regulation and starting and stopping mode management. These functions are described in chapter 9.1.
- Secondary functions, for instance flow rate and pressure instrumentation. These functions are described in chapter 9.2.

10.1. The main functions

The main functions are essential for the thermal regulator’s operation. There are 2 of these: Vulcatherm® temperature regulation and on and off mode management.

10.1.1. Vulcatherm® temperature regulations

This function is provided by a regulator of the PID (Proportional-Integral-Derivative) type integrated into the SGC.

This regulator controls the thermal power supplied by the thermal regulator. In addition to the PID function, this regulator corrects the cooling gain. Generally, it works with a temperature probe inside the thermal regulator, which measures the heating fluid temperature at the outlet.

The Vulcatherm® temperature regulator is mainly controlled from the home page. (See chapter 10.1). This regulator is adjusted using the screen described in chapter 11.3.

10.1.2. Managing operating and stop modes

This is the other main function of the SGC. The thermal regulator consists of a set of devices which must be controlled in a co-ordinated manner.

For instance, not heating if the pump is not operating, or not running the pump if the tank is empty.

The operating modes are selected using the UA1 screen "Operating mode and menu", described in chapter 11.3.1.

The automatic stopping conditions (after a failure or an anomaly) are detailed in chapter 15.2.

10.2. The secondary functions

The secondary functions complete the main functions by adding to the functionality of the thermal regulator.

The secondary functions are:

- Pressure instrumentation (see chapter 10.4)
- The flow rate instrumentation (see chapter 10.4)

11. DESCRIPTION OF OPERATOR MENU

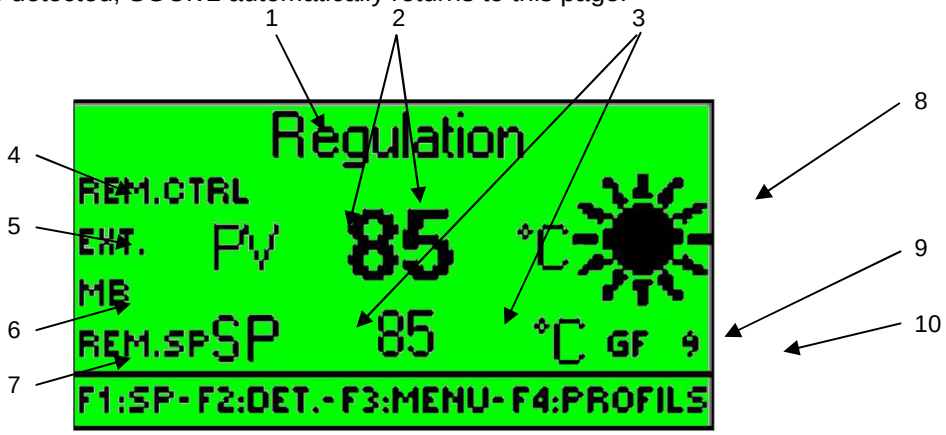
Caution: This manual describes the operation of a Vulcatherm® with a SGC.v2 . If your Vulcatherm has a different model , please refer to the instruction manual SGC " UT30789 ."

The operator menu is a way of monitoring most of the Vulcatherm® functions. It also allows changing the set point. It is available in several languages (see chapter 11.1).
The operator menu includes up to 5 screen pages.
These pages are described below.

11.1. Homepage

The home page presents the summary of the main information. It also allows entering the set point.

If a fault is detected, SGC.v2 automatically returns to this page.



Information and set point input zone :

1 - Machine status indicator, "Regulation" in the example given above (see the SGC.v2 manual for the list of possible messages).
2 - **PV** (Process Value): indicates the current measure, in °C.
3 - **SP** (Set Point) : indicates the current set point. Adjustable digital value.
4 - Indicator of remote or programmed operation:
   a. Indicator unlit: local operation only.
   b. **REM.CTRL** (Remote Control): indicates that the thermal regulator is under remote control.
   c. **PROG** (Programmer): indicates that the thermal regulator operates on program alone.
   d. **PRG/MAN**: indicates that the thermal regulator accepts manual and programmed off and on orders.
5 - Regulation mode indicator:
   a. Indicator unlit: regulation on internal probe.
   b. **EXT**: indicates that external probe regulation is active.
   c. **CASC**. : indicates that cascade regulation is active.
6 - Digital links (Fieldbus or ASCII frames):
   a. Indicator unlit: no bus or active digital links.
   b. **DP**: indicates that the Profibus DP link is active.
   c. **MB**: indicates that the Modbus (RTU or IP) link is active.
   d. **2.0A**: indicates that the CanBus 2.0A link is active.
   e. **2.0B**: indicates that the CanBus 2.0B link is active.
   f. **V485**: indicates that the proprietary Vulcanic link (ASCII frame on RS485) is active.
   g. **ENG**: indicates that the ENGEL proprietary link (ASCII frame on current loop) is active.

7 - Set point origin indicator:
   a. Indicator unlit: local set point modifiable through the keyboard.
   b. **REM.SP** (Remote Set Point): indicates that the remote set point is active. In this case, the set point cannot be entered on the keyboard.
   c. **PROFIL**: The profiles generator (as an option) is in use (the set point cannot be entered on the keyboard).
   d. **HOLD**: The profile generator is held (the set point cannot be entered on the keyboard).
   e. **DISEN**. : The profiles generator is disengaged (the set point can be entered on the keyboard).
   f. **HL/DIS**: The profile generator is held and disengaged (the set point can be entered on the keyboard).

8 - Heating/cooling/limitation indicator:


Heating


Cooling


Heating power limitation

The limitation indication appears in the following cases:
   a. The surface temperature of the heating elements has reached a maximum
   b. The flow rate is momentarily too low
   c. The heating fluid temperature has reached a maximum
   d. The maximum delta T has been reached (only if management of delta T is active).

9 - Special cooling system operation indicator:
   a. Indicator unlit: no particular indication. If a chilling unit is installed, it is off.
   b. **TC**: For Vulcatherm® type 1080x, an overheating message is received from the associated chilling unit, if this message is received, the Vulcatherm® no longer has cooling power.

10 - Segment number: in the case where the "Profile Generator" option is taken, indicates the current segment number.

11.2. Navigation keys

Key 

: allows the current set point to be modified using the numeric keypad and the modifications to be confirmed.

Key 

: is used for changing over to the details screen.

Key 

: is used for changing over to the operating modes & menus screen (chapter 11.3.1 below).

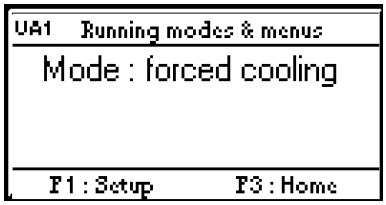
Key 

: this key can only be used on this equipment

11.3. Operating mode and menu access

This user menu subsection includes two screens.

11.3.1. Operating modes & menus :



To open the operating modes action page, press the F3 key from the homepage.
The operating modes are:

- **Regulation**: the pump (or pumps) is operating and Vulcatherm® regulates them to the set point temperature.
- **Pump alone:** the pump (or pumps) is or are operating alone without heating or cooling, for instance, to start a process or to check the flow rate and pressure.
- **Forced cooling**: maximum cooling power is applied
- **Degassing/Forced cooling**: (option replacing the mode given above on some thermal regulators). The circuit evacuates the air that could remain in the circuit and maximum cooling is applied.
- **Filling**: (option available in some models only). The auxiliary pump functions alone, it fills the heat transfer fluid circuit.
- **Regulation + cont. degassing** : Regulation and continuous degassing (option available in some models only). Regulation associated with the evacuation of air trapped in the circuit.

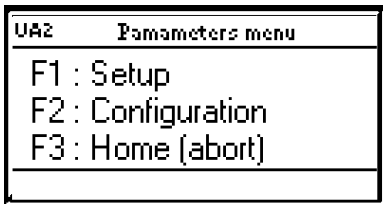
The browsing keys are:

- F1 Key: is used to change over to the menu selection screen (see chapter 5.2.2).
- F2 Key: is used to change over to the profile generator menu (in option).
- F3 Key : return to home.

The browsing keys are:

- F1 Key: is used to change over to the menu selection screen (See chapter 10.3.2).
- F3 Key: return to home.

11.3.2. UA2 Change of menu



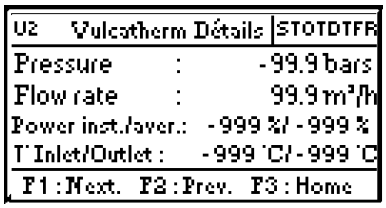
It can be accessed from the homepage, by pressing the F3 Operating modes & menus key then the F1 settings key (see above).

This page gives access to three available menu levels:

- **[F1]: Adjuster menu**: accessible to qualified personnel only.
- **[F2]: Configuration menu**: accessible to authorized personnel only (**Caution**: *access by password*).
- **[F3]: Home (abort)**: return to the current menu (user menu).

11.4. Other user menu screen

11.4.1. U2 Vulcatherm® details



In the top left zone, we find indicators of reasons for heater power limitation.

These reasons can be:

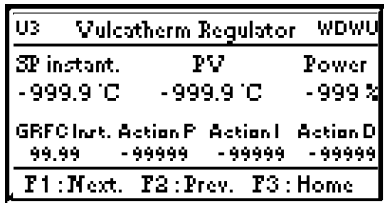
- **ST** (Surface Temperature): The surface temperature of the heating elements has reached a maximum
- **OT** (Outlet Temperature): The temperature of the heat transfer fluid has reached a maximum
- **DT** (Delta T): the maximum Delta T is reached (only if Delta T management is active) in the present case, not used.
- **FR** (Flow Rate). The flow rate is momentarily too low.

In the central zone, the display shows:

- **Pressure**: output pressure (in bar).
- **Flow rate**: the outlet flow (in m^3/h).
- **Instant/average power** : instant and average powers (in %). The average power is calculated for 2 sliding minutes. The powers (instant and average) are positive when Vulcatherm® is heating and negative when Vulcatherm® is cooling.
- **T° Element/Output**: indicates the Vulcatherm® heating element and outlet temperatures. The indicated heating element temperature is the average temperature of the heating element thermocouples in the heater.

This indication is only available on thermal regulators with instrumented heating elements. The starting temperature is the heat transfer fluid outlet temperature (in °C). If Vulcatherm® is regulating on an internal probe, this value equals PV (process value).

11.4.2. U3 Vulcatherm® Regulator WDWU



This screen allows display of the main Vulcatherm® regulator variables only:

- **Inst SP**. (Set Point): the instantaneous set point in °C. If ramps are used, this value may be different from the set point displayed on the homepage which indicates only the final set point. In addition, for cascade regulation, this parameter is simply equal to the process regulator output value.
- **PV** (Process Value): temperature in °C, measured on the internal or external probe, depending on the selection.
- **Power**. : Power demand on thermal regulator as a % of the nominal power. It is negative if the thermal regulator is cooling.
- **Instantaneous HCRG** (Instantaneous Hot Cold Relative Gain): a way of adapting the cold outlet gain relative to the heat outlet gain (and therefore modifying the respective value of the cold proportional band with respect to the hot proportional band). The higher the available cooling power the lower it is.

This value depends on the HCRG at 65°C entered on page C5, the cooling law and the instantaneous temperature difference between the heating circuit and the cooling source.

- **Action P, Action I, Action D**. PID Actions: Displays Proportional, Integral and Derivative actions. If there is no saturation the sum of the three actions is 10 times the applied power in %.
- **WD/WU** Indication (top right of screen): in cascade mode, they indicate whether the regulator is in "Winddown" or "Windup". That is, if the Vulcatherm® regulator is momentarily incapable of performing the Process regulator set points. (Because of an available power's lack).

11.4.3. U4 Master Regulator operation (Process)
If applicable, see the corresponding chapters in the "UT30789" manual.

11.4.4. U5 Elements T° and power:
If applicable, see the corresponding chapters in the "UT30789" manual.

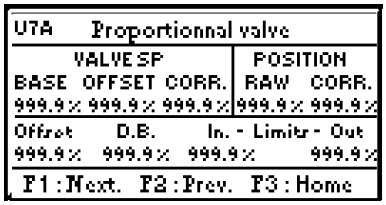
11.4.5. U6 Profibus DP link status
If applicable, see the corresponding chapters in the "UT30789" manual.

11.4.6. U6B Internal bus status
If applicable, see the corresponding chapters in the "UT30789" manual.

11.4.7. U6 Digital link status
If applicable, see the corresponding chapters in the "UT30789" manual.

11.4.8. U7A Description of the "Proportional valve positioner" page

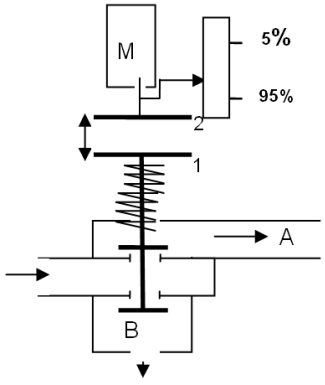
Only for the Vulcatherm equipped with a proportional valve



From top to bottom and from left to right, we find:

- **VALVE SET POINT**: due to the difference between the electric set point and the mechanical set point, and also to the possible presence of a mechanical clearance, it is necessary to make corrections in the requested position (set point) of the proportionate valve.
  - **BASE**: position of the valve requested by the regulator
  - **OFFSET**: basic set point offset corrected for mechanical clearance of the valve.
  - **CORR**. above set point corrected to allow for position of mechanical travel limit switches.
- **VALVE POSITION**: current rough position
- **Offset**: compensation for mechanical clearance as set in the configuration menu in the table "cf. proportional valve position".
- **D.B.** : Positioner dead band
- **Limits:**
  - **Inlet.** : Extreme position reached on inlet
  - **Outlet.** : Extreme position reached on outlet
- **Position** :
  - **RAW** : Raw valve position
  - **CORR** : Valve position with correction

Mechanical clearance

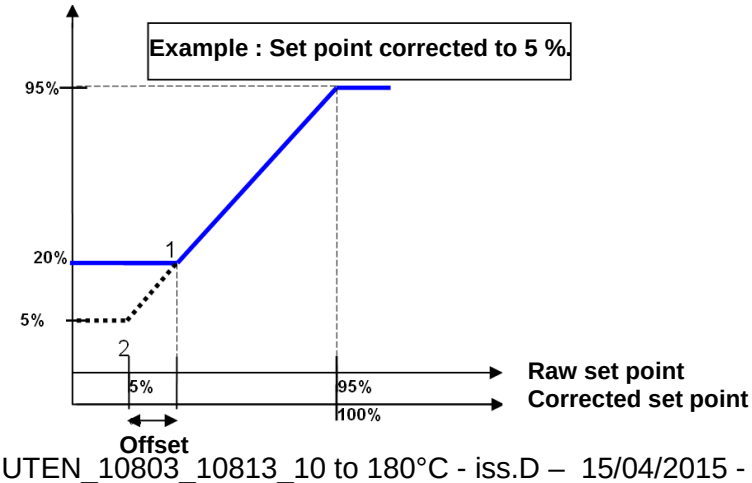


By construction, some valves have a mechanical clearance between valve pusher 1 and motor pusher 2, creating a dead band in which the valve no longer moves although the motor is running. This clearance generates non-linearity, which could be detrimental to correct operation of the Vulcatherm®. It has to be corrected. The principle of correction explained below in the case of a distribution valve used to control cooling.

AB Fluid

In the figure opposite, when motor pusher 2 is not in contact with valve pusher 1, the spring released and the valve comes to the high position. All the fluid from AB runs through circuit A (no cooling).

After compensation for the clearance when pusher 2 presses against pusher 1, the spring is compressed, the valve drops to the low position and liberates into circuit B an amount of fluid proportional to the descent of the valve.



11.4.9. Direct air cooling
Not applicable for this machine

11.4.10. U8A Description of the "Cooling parameters" page. U8B Chilling unit parameters (thermostatic relief)
Not applicable for this machine

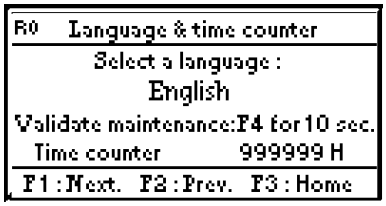
11.4.11. U8C Chilling unit parameters (model with fluid superposition)
Not applicable for this machine

11.4.12. U9 Profile generator
If applicable, see the corresponding chapters of the SGC manual “UT30789”.

11.5. ADJUSTER Menu

The adjuster menu allows basic thermal regulator settings. The pages of this menu are described in the following paragraphs, available in several languages.

11.5.1. R0 Languages and time counter

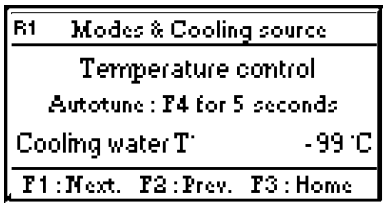


From top to bottom, it displays:

- The language selector. It allows selecting the display language of the operator and settings menus from:
  - French (Français By default).
  - English
  - German (Deutsch).
  - Spanish (Español).
  - Portuguese (Português)
- **Time counter** : Indicates the number of running hours of the main pump.

  If maintenance validation is necessary the "**Maintenance validation: F4 for 10s"** indication appears. To validate the maintenance, hold the F4 key down for 10 seconds.

11.5.2. R1 Temperature regulation / Power proportioning



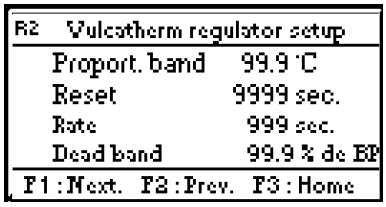
From top to bottom, are displayed:

- Mode selection:
  - **Temperature regulation**: normal regulation operation.
  - **Power proportioning**: a way of establishing a constant heating or cooling power factor. Essentially, this mode is intended for regulation testing and development. Without surveillance, the outlet temperature of the Vulcatherm® can reach the temperature limits (maximum temperature if the sum of the power is positive, otherwise minimum temperature).
- **Cold water T°**: the cold water temperature is a digital value on which the cooling power calculation is based.
- **Cold water flow rate**: The minimum cold water flow rate needed to provide the cooling power.

If the conditions for starting a self-adjustment cycle are fulfilled, the indication "For self-adjustment: F4 for 5s" appears.

To start the self-adjustment cycle, hold the F4 key down for 5 seconds.

11.5.3. R2 Vulcatherm® regulator set-up



In the central zone, we find:

- **Prop. band**. : Proportional band. Digital value adjustable between 0.1°C and 99.9°C.
- **Integral**: digital value adjustable between 1 and 9999 seconds. The integral time cannot go below 4 times the rate (derivative) time (See below). In some cases, decrementing the integral time can result in automatically decrementing the rate time.
- **Rate**: digital value adjustable between 0 and 999 seconds, with a maximum of a quarter of the integral time (See above). The display "0" means "rate time zero = no correction of rate". In some cases, decrementing the integral time can result in automatically decrementing the rate time.
- **Dead band**: digital value adjustable between 0 and 30% of the proportional band.

11.5.4. R2A. Process regulator

See the corresponding chapter in the “UT30789” manual.

11.5.5. R2B. Ramps

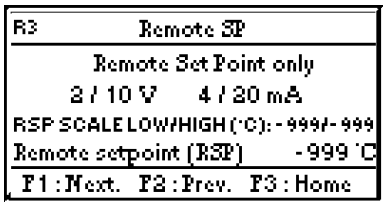
See the corresponding chapter in the “UT30789” manual.

11.5.6. R2C. Delta T

See the corresponding chapter in the “UT30789” manual.

11.5.7. R3 Remote set point:

In the central zone, we find:

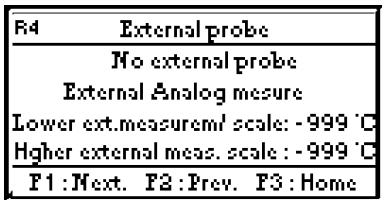


- The set point source selector permits choice between:
  - **Local set point only:** The set point can only be input on the home page.
  - **Remote set point only:** the set point used comes from the external signal (digital or analogue). It cannot be modified on the home page.
  - **Remote set point on input I14:** an external on/off signal allows switching between the 2 previous modes.
  - **Remote set point controlled by BUS:** A BIT from the digital link allows passing in remote set point mode. This option is functional only if a digital link of ModBUS or ProfiBUS type is used.
  - **Remote set point on remote control:** Vulcatherm® automatically switches to remote set point mode as soon as the remote monitoring is active.

The selection of the remote set point displays:

- The selector of the analogue input scale allows selecting between:
  - **2/10V 4/20mA:** select this mode if your signal has a 20% offset origin. This is particularly the case for 4/20 mA analogue current loops (Only if the setting is wired on the Snap-In module mounted on the cabinet door).
  - **0/10V 0/20mA:** Select this mode if your signal does not have an offset origin. This is particularly the case for 0/10 volt analogue signals (Only if the setting is wired on the Snap-In module mounted on the cabinet door).
  - **4/20mA:** select this mode if your signal has a 20% offset origin. This is particularly the case for 4/20 mA analogue current loops (Only if the setting is wired on the 30789.30 cabinet base module).
  - **0/20mA:** Select this mode if your signal does not have an offset origin. This is particularly the case for 0/20 mA analogue current loops (Only if the setting is wired on the 30789.30 cabinet base module).
  - **-20/20mA:** Select this mode if your signal has an offset origin. This is particularly the case for -20/20 mA analogue current loops (Only if the setting is wired on the 30789.30 cabinet base modules).
  - **2/10V:** select this mode if your signal has a 20% offset origin. This is particularly the case for 2/10 V analogue signals (Only if the setting is wired on the 30789.30 cabinet base module).
  - **0/10V:** Select this mode if your signal does not have an offset origin. This is particularly the case for 0/10 V analogue signals (Only if the setting is wired on the 30789.30 cabinet base module).
  - **-10/10V:** Select this mode if your signal has an offset origin. This is particularly the case for -10/10 V analogue signals (Only if the setting is wired on the 30789.30 cabinet base module).
- **HIGH/LOW SET POINT SCALE (°C)**: Low and high set point scale. For the lower limit, digital value adjustable between -100°C and the top of the remote set point scale. If this parameter is less than the lower limit of the local set point scale, the SGC v2 will be limited to this value (lower limit of the local set point scale). For the upper limit, digital value adjustable between the lower limit of the remote set point scale and 600°C. If this parameter is greater than the top of the local set point scale, the SGC v2 will be limited to this value (top of the local set point scale).
- **Remote set point Instant.** : Instantaneous value of the remote set point, according to the scales given above.

11.5.8. R4 External probe:



In the central zone, from top to bottom and from left to right, we find:

- Selection of the external probe
  - **External measurement deactivated**: the external probe is not used; regulation is carried out on the internal probe of Vulcatherm®.
  - **External measurement activated**
  - **External measurement active on condition**
  - **Cascade regulation activated** (option, see description of cascade regulation in the SGCV2 manual).
  - **Cascade regulation on input I16/32**. Same remark as above.
- Fault filter/value:
  - **Filter fault: External sensor fault time delay**
  - **Value: Current value of external sensor**.
- Choice of measurement source:
  - **Analogue measurement**. : External analogue measurement,
  - **T° extern. By bus**: external measurement by digital link (option).
- Choice of measurement selection:
  - **Select by contact**: selection by electric contact,
  - **Selection by F4**: selection by the F4 key on the homepage (only if the profile generator option is not available),
  - **Selection by bus**: selection by digital link.
- **Lower scale**: digital value adjustable between -100°C and the analogue measurement top of scale. If this parameter is lower than the bottom of the local set point scale, the S.G.C. will be unable to use the measurements located beneath the bottom of the local set point scale.
- **Higher scale**: digital value adjustable between the bottom of the analogue measurement scale and 600°C. If this parameter is higher than the local set point scale top, the S.G.C. will be unable to use measurements located above the top of the local set point scale.

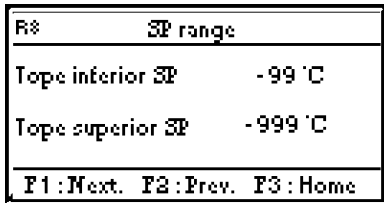
11.5.9. R5 Analogue Copy No.1
See the corresponding chapter in the “UT30789” manual.

11.5.10. R6 Analogue Copy No.2
See the corresponding chapter in the “UT30789” manual.

11.5.11. R6A Analogue Copy No.3
See the corresponding chapter in the “UT30789” manual.

11.5.12. R7 Temperature alarm
See the corresponding chapter in the “UT30789” manual.

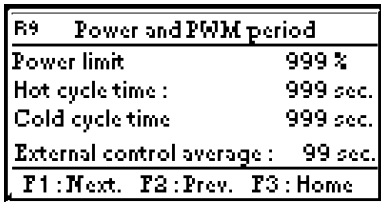
11.5.13. R8 Set point scale



Defines the range for the SP set point (local or remote):

- **Lower SP limit**: Digital value adjustable between the bottom of the set point scale and the upper SP limit
- **Upper SP limit**: Digital value adjustable between the lower SP limit and the top of the set point scale.

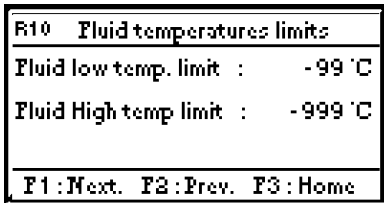
11.5.14. R9 Power and PWM period



In the central zone, we find:

- **Maximum power**: It is possible that the heating efficiency is excessive. The heating power can be controlled by displaying a maximum power percentage of less than 100% (Example: a 20 kW Vulcatherm® only dissipates 12 kW when its MAX POWER parameter is set to 60%).
- **Hot cycle time**: Digital value which must be adjusted at max. 1 second. In the case of Vulcatherm® having an individual heating control for each heating element, this parameter is inoperable and the cycle time is of 1.11 second.
- **Cold cycle time**: Digital value adjustable between 10 and 120 seconds. Normally adjusted to 30 seconds. Evidently, this parameter is inoperable in the case of an air-cooled Vulcatherm® (10823 with air condensation
- and 10833). Sometimes, it can also be inoperable in the case of 10823 with water condensation (according to the type of cooling water flow control valve).

11.5.15. R10 - Fluid temperature limits



Fluid low temp. limit: Digital value adjustable between the bottom of the set point scale and 90°C, exclusively when the measurement probe is external. Allows limiting the minimum output temperature, independent of any other condition.
Fluid high temp. limit: Digital value adjustable between 0°C and the high set point scale, exclusively when the measurement probe is external. Allows limiting the maximum output temperature, independent of any other condition.
If the 2 values are overlapping, the bottom limit is aligned on the top limit.

11.5.16. R11 - Digital link
If applicable, see the corresponding chapters in the “UT30789” manual.

11.5.17. R11A Ethernet/IP
If applicable, see the corresponding chapters in the “UT30789” manual.

11.5.18. R12 Date and time
See the corresponding chapter in the “UT30789” manual.

11.5.19. R12A, B, C and D Programmable
If applicable, see the corresponding chapters in the “UT30789” manual.

11.6. CONFIGURATION MENU

The screen pages shown in this chapter are reserved exclusively to users having all the skills needed for setting up a thermal regulator. The input of an incorrect parameter can cause extensive damage to properties and persons.

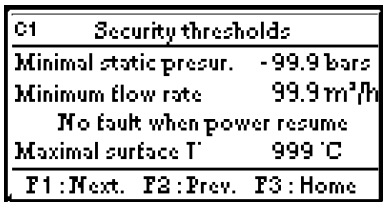
Caution: This menu is exclusively bilingual in French and English.

Access requires a password, using the following procedure:

- Go to the homepage (see chapter 5.1.3),
- Press the F3 key to switch to the operating mode and menu screen.
- Press the F1 key to open the menu selection screen.
- Press the "Configuration menu" F2 key (see chapter 5.2.2),
- Input the password to log on to the configuration menu. If you don't have it, please contact the Vulcanic's after-sales service.

11.6.1. C1. Safety Thresholds

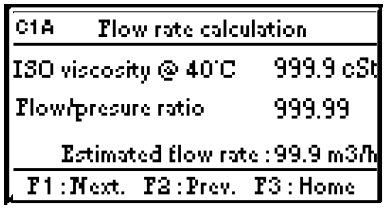
In the central zone, we find:



- **Minimum static pressure**: Minimum static pressure of the heating fluid, measured on CPP.
- **Minimum flow**: Flow rate beneath which the "No flow rate" error message appears.
- **Fault / no fault when power resumes**: Activate or deactivate the "Power return" message on energising.
- **Maximum surface T°**: Maximum authorised surface temperature of the heating elements.

11.6.2. C1A. Flow meter parameters

In the central zone, we find:



- **ISO Viscosity**: Allows setting the kinematic viscosity of the fluid. The parameter is used by the flow activation algorithm.
- **Coeff. Flow rate/Pressure**: Allows calibrating the flow display panel in m3/h

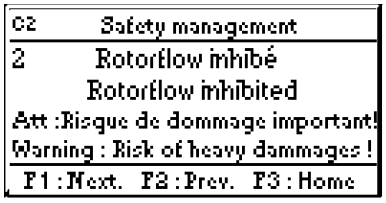
11.6.3. C1B Flow rate coefficients

If applicable, see the corresponding chapters of the SGC manual "UT30789".

11.6.4. C2. Safety devices

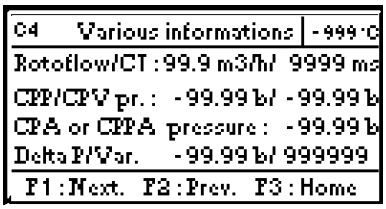
This screen allows the safety functions to be deactivated.

Some safety functions are ensured by electrical wiring and therefore cannot be deactivated. They concern the heater temperature thermostat, the tank safety thermostat (if there is one) and the pump thermal relay or relays.



CAUTION: ***INHIBITING THE SAFETY DEVICES CAN CAUSE MAJOR DAMAGE TO PROPERTY AND PERSONNEL.***

11.6.5. C4. Miscellaneous information



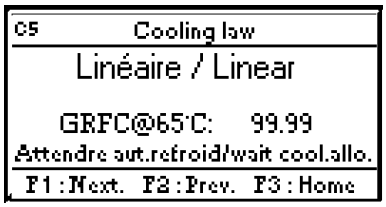
This screen shows, in read-mod only, various useful information to check the correct operation of the thermal regulator.
In the top right zone we find the temperature of the heat sink. This value is only valid if an electronic power board having a thyristor heating control is used.
In the central zone, from top to bottom and from left to right, we find:

- **Rotoflow**: Cooling water flow rate measured by the Rotoflow flowmeter.
- **CPV pressure**: Used for the calculation of the flow rate and for the display of the effective pressure present on the usage outlet pipe.
- **CPP pressure**: Used for calculating the flow rate.
- **CPPA pressure**: Used to check the flow of the auxiliary pump P2 and the absence of clogging of the filter.
- **Delta P**: indicates the net pressure difference (corrected with the measurement offset) between CPV and its reference probe (CPP, CPA or the atmosphere) depending on the Vulcatherm® model. This value is valid only if the main pump is operated (else the value displayed is the last delta P before stopping of the pump).
- **Var**. : Variance. Indicates the variance (square of the standard deviation) of the Delta P signal above. The unit is kPa^2.

11.6.6. C4A Electrical unit temperature

See the corresponding chapters of the SGC manual “UT30789”.

11.6.7. C5 Cooling law



This screen allows defining the rules used by SGC to control cooling. Naturally, these rules depend on the thermal regulator circuits. That means that they cannot be modified freely. In the central zone, the display is:

• Choice ofthe law

- **Linear (Cooling by Proportionnal valve).** This law is adapted to the "direct cooling" thermal regulator that is when cooling is obtained by the direct injection of cooling fluid into the heat transfer circuit. This solution includes a number of constraints, the most obvious being that the cooling fluid has to be the same as the heating fluid.
- **Quadratic (Cooling by valve).** Generally, this law is used for liquid/liquid exchanger cooling.
- **Superposition (liquid/liquid).** Not used
- **Superposition (liquid/liquid). Operation without cooling allowed.** Not used
- **Air cooled superposition**: Not used
- **Fluid superposition (with chiller).** Not used
- **Direct air cooling** Not used.
- **Standard chiller (direct).** Not used.
- **Vulcafroid Chiller only** Not used.
- **Boiler:** If boiler

• **GRFC @ 65°C**: Adjustable digital value between 0.05 and 20.0. This is the ratio between the heating power and the cooling power with a cold and hot source temperature differential of 65°C.

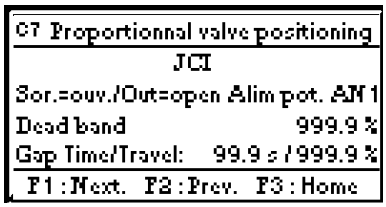
• **Cooling authorisation selection:** Only for a Vulcatherm® 1080x equipped with an Ethernet card.

- **Wait for cooling authorisation**: The Vulcatherm® is waiting for overheating information for the associated cooling unit (Vulcafroid). If this signal has been received the Vulcatherm® will no longer supply cooling power.
- **Do not wait for cooling authorisation**: The Vulcatherm® does not have an associated cooling unit (Vulcafroid).

11.6.8. C6 Fluid superposition management

Not used in this machine

11.6.9. C7-Proportional valve positioning:



This page C7 concerns the general usage positioner, used for the cold fluid injection valve in the main circuit. If your machine has a water-cooled chilling unit and condensation pressure From top to bottom and from left to right, we find:

- Types de Valve:
  - **No Prop. Valve**. : No proportional valve. Never select this option.
  - **Regular valve:** proportionate valve with standard coupling (without clearance).
  - **Samson K valve :** K type clearance valve.
  - **JCI:** JCI valve (Johnson control) with clearance in the copy potentiometer.
- Action direction:
  - **Out=Open:** The motor output corresponds to the increase in cooling**.**
  - **Out=Close:** The motor output corresponds to the reduction in cooling
- Position copy potentiometer polarisation. This power supply can be:
  - **Exter. pot. power supply : use of an external power** supply
  - **Pot. power supply AN1:** use Analogue output no. 1 (this output is then no longer available).
- **Dead band**: Range where the motor does not try correcting the error (1 to 3% depending on the motor): if the value is too small, the motor never stops, which reduces its life cycle; too high a value can interfere with the regulation.
- **Offset**: Mechanical clearance compensation (in % of the total electric travel). Appears only if valve K is selected.
- **Clearance duration/travel**: Appears only if JCI valve is selected. Compensation for the copy potentiometer mechanical clearance. The two parameters are:
  - **Duration**: time (in seconds) required to take up the whole potentiometer clearance**.**
  - **Travel: The mechanical clearance of the potentiometer expressed in % of the electric travel.**

CAUTION:

THE VALVE IS CHOSEN IN THE FACTORY. IT MUST NOT BE MODIFIED. CHOOSING ANOTHER LAW CAN CAUSE MAJOR DAMAGE TO PROPERTY AND PEOPLE.

11.6.10. C7A - Condenser proportional valve positioner
If applicable, see the corresponding chapters in the"UT30789" manual.

11.6.11. C8 - Chilling unit 1: Fluid & safety devices
Not used in this machine.

11.6.12. C9 - Other chilling parameters
Not used in this machine.

11.6.13. C9A - Electronic relief
Not used in this machine.

11.6.14. C10 - Condensation control. (HP - high pressure)
Not used in this machine.

11.6.15. C10A - Chiller unit switch off
Not used in this machine.

11.6.16. C11 - State of the external bus
See the corresponding chapter in the"UT30789" manual.

11.6.17. C12 - Digital link:
See the corresponding chapter in the"UT30789" manual.

11.6.18. C13 - Repeater configuration
See the corresponding chapter in the"UT30789" manual.

11.6.19. C13A - Input D configuration
See the corresponding chapters in the"UT30789" manual.

12. ECONOMICAL OPERATION, OPTIMISATION OF REGULATION PARAMETERS

12.1. General

Temperature regulation is executed by a manually-adjusted P.I.D regulator. The energy consumed in the network (electric current and cooling water) also depends essentially on this optimized adjustment.
The adjustments concerned (see chapter 11.3) are:

- **The 3 PID parameters**: proportional band, integral and rate time. Adjust the regulation parameters according to the position of the measurement probe, the thermal inertia and to the receiver oscillation period.
- Hot cycle time: normally set to 1 second in the version including static power units.
- Cold cycle time: normally set to 20 seconds in the version including an electromechanical valve. Increasing it from 20 to 40 s allows the life of this solenoid valve to be doubled, from about 3500 to 7000 h in continuous operation require alternating cooling.

  Consequently this new setting is recommended, on condition that it retains acceptable process temperature stability during cooling operations.
- Maximum heating power: in contrast to the general case, the heating effectiveness can be excessive compared to the cooling power. The heating power can be controlled by displaying a maximum power percentage of less than 100 % (Example: a 20 kW Vulcatherm® only dissipates 12 kW when its MAX POWER parameter is set to 60 %). This optimisation must be done in coordination with the hot cycle time for the version controlled by an electromechanical switch.
- Relative cold / hot gain: when the regulator requires cooling, the immediate drop in the measured temperature can be excessive, because the Vulcatherm® cooling power is often excessive for the process to which it is connected. Consequently this cooling power should be limited by progressive reductions of the RELATIVE COLD GAIN. This optimisation must be done in coordination with the cold cycle time. The reduction of the relative cold/hot gain creates the same effect as the partial closure of a flow rate limiter on the cold water pipe, without increasing the instantaneous outlet temperature and whilst obtaining full benefit from the cooling power in the “FORCED COOLING” configuration.

  In contrast, increasing the RELATIVE COLD GAIN allows compensation for the weakness of cooling when the set point temperature is close to the cooling water inlet temperature.

12.2. Self-adjustment

The SGC has a self-adjustment algorithm based on the Ziegler & Nicols cycle. To be able to start that cycle, the process temperature (PV) must first differ from the set point by less than 5°C. When this condition is satisfied, in regulation mode, the cycle can be started.
Choose a set point near the temperature at which Vulcatherm® will regulate most often.

However, the set point must not be too close to the authorised limits for the heating fluid. Indeed, if one of these limits is reached during the cycle, the cycle is automatically aborted.

IMPORTANT NOTES

- Using the self-adjustment function is only justified in the particular case where the default regulation parameters are unsuitable or when they cannot be located quickly.
- The self-adjustment cycle is always executed through oscillations around the set point.
- Before triggering it, make sure that the load is representative of the final operating configuration, wait for the measurement to have intercepted the set point for at least 5 minutes, then check that the process will accept considerable temperature overshoots or undershoots without any major damage.
- Failure to comply with these precautions is liable to produce unsuitable adjustment values or the abortion of the self-adjustment cycle. In the latter case, the S.G.C returns to the P.I.D. values that it had memorised by default before the self-adjustment cycle began.

  This cycle is also aborted in the event of a temperature limitation at the surface of the heating elements or if there is a fluid outlet temperature limitation. It can be interrupted at any time by two successive pushes on the "AUTO" push-button.
- The P.I.D. parameters calculated during self-adjustment are approximate. They correspond to a highly dynamic PID (low proportional band, low integration time constant and rate equalling one quarter of the integral).
- The self-adjustment cycle only serves to provide rough values of these parameters which can eventually be refined later by a specialist.

12.3. Heating power control

There are four modes for heating power control.
These four modes are:

- Slow wave train
- Fast wave train
- Rotary incremental
- "Step-control"

The slow wave train (power dosing by a single switch working in pulse width modulation over a period of a few tens of seconds) is not suited to this type of thermo regulator. It is only mentioned for reference. It will not be considered further in this manual.
The others three modes are described below.

12.3.1. Heating control by fast wave train (100% thyristor)

This is the most universal mode, suitable for all types of applications. It consists of modulating the width of the pulses applied to the heating system. It is called "fast" because the pulse frequency, generally in hertz, is too fast for an electromechanical switch (high noise and low lifetime). Thyristor switching is indispensable for this mode.

As thyristors become expensive and bulky over 25 kW, this mode is reserved for power thermo-regulators less than or equal to 25 kW. Above this power, it is advisable to use the modes described below.

12.3.2. Incremental rotary heating control

This mode is only applicable to systems using several heating elements. It consists of controlling the heating power in stages, by a slow wave train. The period for each wave train is equal to the cycle time multiplied by the number of stages. The wave trains are dephased between each other by a multiple of the cycle time. Due to this the system acts as if the wave train was divided by the number of stages. In contrast, the period applied to the switches for each stage is multiplied by the number of stages.

For example, for a total power of 30 kW, divided into 3 stages of 10 kW each, and with a cycle time of 30 seconds, the power wave is that of a 10 second wave train (30 seconds divided by 3), whereas individually the switches are only subject to a change of state every 90 seconds (30 seconds multiplied by 3).

As the rotary incremental control mode requires several stages, it is generally only used for powers greater than 25 kW.

From another side, slow wave control of each stage prevents the use of so call "high flux" heating elements (heating resistances). It is thus generally not used above 40 kW.

Rotary incremental mode is thus used for heating power greater than 25 kW and less than or equal to 40 kW. Above this, the "step-control" mode described below is used.

IMPORTANT NOTES

- Due to its operating principle the incremental rotary mode introduces a mean delay equivalent to the cycle time (one period) into the control loop. This delay cannot be neglected for the PID controller.

  Consequently, when the incremental rotary mode is used, the regulator proportional band must not be less than 6°C, and the integral time constant must not be less than 90 seconds.

- The result of the above note is that using auto-regulation when the power control is in "rotary incremental" is not recommended.

12.3.3. "Step-control" heating control

This is the most elaborate mode. It allows precise and economical control of powers up to several thousand kW.

Like the "rotary incremental mode", step control is only applicable to systems using several heating elements. In "step-control" the application of the required power is obtained by the use of a combination of fixed power and a single variable power stage. The variable power stage is thyristor controlled.

To avoid threshold effects, at least two fixed stages must have lower power than the variable stage. For thermo-regulators these stages have half the power of the thyristor stage.

In the step-control control case it is advisable to separate the concepts of heating element and stage (whereas for the rotary incremental control seen above, a heating element generally corresponds to a stage):

- A heating element is an equipment sub-assembly (a heating resistance)
- A stage is a fraction of the total power that can be controlled separately from the other stages.

A stage can comprise:

- 1 single heating element.
- 2 simultaneously controlled heating elements. This is the case for thyristor stages for a Vulcatherm® with power greater than 75 kW. For the record, we recall that this can also be the case for certain fixed stages for a Vulcatherm® with power greater than 125 kW.
- Half the power of a heating element. In this case an electrical trick is used to be able to trigger the half power. For 60 and 75 kW Vulcatherms®, this special control is used to create 2 power stages equal to half the thyristor stage.

The fixed stages must not be switched (put on or off) too frequently. To avoid switching too frequently, 3 delays are used:

- Starting delay for a fixed stage, generally set at 25 seconds.
- Switch off delay for a fixed stage, generally set at 5 seconds. This delay only concerns power variations. If Vulcatherm® is switched off, or if a limiter comes into action, the stage or stages concerned are immediately switched off.
- Starting delay for a fixed stage, after action of a limiter, generally set at 60 seconds.

IMPORTANT NOTES

- As we have just seen, the step-control mode ideally works at quasi-constant power. Checking the stability of the PID regulator is thus indispensable.
- The auto-adjustment mode (see §14.2) is not optimised for step control command. The use of auto-adjustment is thus not recommended on a Vulcatherm® with this type of control.

13. MESSAGES

This chapter presents several messages likely displayed on the status indicator of the machine.
You can find all the messages in the SGC manual “UT30789”.

13.1. Status messages:

These messages refer to the status of the thermal regulator. They comprise the messages corresponding to a special operating mode and the messages reflecting the progression of the self-adjustment cycle.

13.1.1. Operating mode:

- **Initialisation**: The machine is being initialised.
- **Vulcatherm® ready**: The thermal regulator is ready to operate.
- **Pump alone**: The machine operates in "Pump alone" mode.
- **Forced cooling**: the machine will run in the "Forced cooling" mode
- **Regulation**: (see User menu)
- **Power proportioning**: The machine runs in "Power proportioning" mode (see User Menu)

13.1.2. Self-adjustment cycle:

- **Self-adjustment Ph1 – Identification** first self-adjustment phase, identification of the nature of the process (endothermic or exothermic)
- **Self-adjustment Ph2 - Distancing**: second self-adjustment phase, speed build up
- **Self-adjustment Ph3 - Approach**: third self-adjustment phase, approach
- **Self-adjustment Ph4 - Oscillation 1**: fourth self-adjustment phase, first oscillation
- **Self-adjustment Ph5 - Oscillation 2**: fifth self-adjustment phase, second oscillation
- **Self-adjustment Ph6 - Measurement**: sixth self-adjustment phase, measurement
- Self-adjustment successful
- **Timeout autotune phase 1.** : Abort in phase 1
- **Timeout autotune phase 2.** : Abandon in phase 2
- **Timeout autotune phase 3.** : Abandon in phase 3
- **Timeout autotune phase 4.** : Abandon in phase 4
- **Timeout autotune phase 5.** : Abandon in phase 5
- **Timeout autotune phase 6.** : Abandon in phase 6
- Err Autotune-**Over/Undershoot <0. :** abandon on error, the cycle gives a reverse result

13.2. Failure or anomaly messages

These messages replace the status messages in case of failure or anomaly.

- **Lack of flow rate:** The flow rate of the thermal fluid is below the minimum contractual value. Check the opening of the isolating valves, the cleanliness of the filters, or the receiver load loss. Degas the installation if necessary.
- **Init. impos. too much noise on Delta P:** the pressure sensor signal is unstable and it is impossible to calibrate this sensor. The problem can originate from the probe itself, its electrical connection or even from the acquisition card of the SGC.
- **DeltaP >> during initialisation:** the pressure deviation is too great compared to the threshold value during initialisation.
- **CPP signal outside limit**: concerns the pump pressure sensor. Break in one of the power supply wires or measurement signal out of tolerance.
- **CPV signal outside limit:** concerns an output pressure probe. Break in one of the power supply wires or measurement signal out of tolerance.
- **Outlet pressure too high**: The Vulcatherm® outlet pressure has exceeded the authorised maximum.
- **Very low pressure:** the pump pressure has reached the authorised minimum.
- **Pump fault**: Primary pump thermal relay cut out.
- **Thermostat triggering:** overheating of heater or tank.
- **Emergency stop:** Emergency stop button pressed.
- **Internal T° probe fault:** break in one of the 3 wires or abrupt short circuit in the internal probe.
- **External T° probe fault:** Same as the internal temperature probe, see above.
- **Fluid level low:** the tank level is very low. Check that there is no leak and add fluid.
- **TCK limitation fault Element T°:** break in one of the 2 wires of a thermocouple in a heating element.
- **Error: TCK or heating position:** Incremental rotary or step-control mode only. Indicates that either a heating elements is not powered, or that one or more thermocouples are not correctly installed.
- **Voltage return:** if the "Voltage return fault" option is activated, this message will be displayed after switching on the machine.

13.3. Information messages

These messages scroll in alternation with the status or anomaly messages.

- **Band alarm:** Temperature deviation between measurement and set point exceeded.
- **High alarm:** Maximum authorised temperature exceeded.
- **Low alarm:** Minimum authorised temperature is exceeded.
- **Safety devices INHIBITED:** Indicates that the safety devices are inactive

CAUTION:

INHIBITING THE SAFETY DEVICES CAN CAUSE MAJOR DAMAGE TO PROPERTY AND PEOPLE (See Configuration Menu).

- **Maintenance necessary:** the machine requires some planned maintenance. To find out the operations done see chapter 17, to confirm the maintenance operation you must refer to chapter 11.1.
- **URGENT-Replace the battery**: the battery must be replaced. Not replacing the battery will lead to the loss of Vulcatherm® parameters (see chapter 17.3, for the battery change procedure).

14. TROUBLESHOOTING

Troubleshooting and maintenance actions must be carried out by a trained and competent professional using this user manual and the hydraulic and electrical files. Generally, operating anomalies are displayed in plain language on the S.G.C message indicator. However, if unable to quickly solve a malfunction problem, contact the After Sales Service at VULCANIC or its local dealer.

CAUTION:

The CPP and CPV pressure probes are essential measuring devices, which ensure the monitoring of the Vulcatherm® hydraulic parameters. Take care not to mechanically block, shock or constrain them, during the assembly or removal operations.
Their output voltage calibrated for values of 4 mA for -1 bar and 20 mA for 15 bars.

15. PARAMETER SETTING

- SGC parameter setting : See the SGC manual instruction « UT30789 ».
- Parameter setting of the overload pum protection : Use the pump(s) rating plate.
- Setting the output safety temperature thermostat (THx) : 10°C above the maximal température indicated on the rating plate (Factory values) or or a lower temeperature if the receiver requires. The value must never be higher at the factory value

16. MAINTENANCE

16.1. Vulcatherm® maintenance

Whenever the message "MAINTENANCE NECESSARY" is displayed (10 hours, 200 hours, 1000 hours, then every 2000 hours):

Check the presence of a sieve filter in the cooling water inlet.

CAUTION:

Non-compliance with this instruction can result in the cooling solenoid valve blocking in the open position. On industrial water supply networks, it is essential to install a 100µm filter upstream, as these present a high risk of pollution.

- Check the clogging state of the 2 filters on the heating fluid circuit.
- Check the cleanliness of the ventilation grids, inside the electric cabinets and hydraulic enclosures.
- Check the tightening of the electrical connections and the condition of the relay contacts.
- Monitor the correct operation of the regulation.
- Monitor the condition of the joints and thermal insulation so as to act preventively to avoid the risk of burns to the personnel.
- Test the operation of safety devices and their setting value.

Whenever the flow rate alarm is triggered due to clogging of filter F1:

- Close the isolation valves upstream and downstream of the filter in use.
- Close the isolation valves upstream and downstream of the standby filter.
- Restart the equipment.
- Remove, clean and refit the clogged component.

After 6000 hours of operation:

- Completely drain the installation in order to regenerate the quality of the heating fluid.
- Measure the change in the contractual values: flow rate, pressures, currents, reaction times, temperature deviations (see Vulcatherm® test sheet).
- Replace the cooling solenoid valve if its operating frequency has allowed it to reach 800,000 cycles.

  REMINDER: You can inhibit the maintenance message in the "Adjuster" menu (see chapter 11.1).

16.2. SGC maintenance

Except for replacing the data backup battery (described in chapter 17.3), SGC does not require any special maintenance

17. DATA BACKUP BATTERY REPLACEMENT PROCEDURE

See the corresponding chapter in the “UT30789” manual.

18. RECOMMENDED LIST OF SPARE PARTS

See the electrical and hydraulic lists. This is another supply contract. Most standardised components are available in stock at VULCANIC or with its supplier.

- First emergency batch:
  Cooling solenoid valve, mechanical pump packing, fuses and bulbs.

- Second emergency kit:
  Regulation and limiting thermocouples and sensors, safety thermostats, analogue pressure sensors, pressure switches, heating elements, power unit (if any) or heating power switch.

- Third emergency kit:
  Motor pump system, cooling exchanger or compact heating / cooling assembly, heater body, centralised management system (S.G.C).

19. WARRANTY

Its duration is one year as from commissioning, and at the latest 24 months after provision. The terms and conditions of the guarantee are compliant with the VULCANIC’s general sale’s conditions or with any most favourable clauses indicated in the contract. In particular, the manufacturer will not guarantee the performance of the process to which Vulcatherm® connected, when it has not been commissioned for a design study service.

Vulcatherm® guarantees the NON-DEGRADATION of the thermal fluid by cracking or oxidation, in the conditions of operation defined by the initial contract, which govern the settings of the limiters and safety devices.

The repair of the defective parts or manufacturing defects will be carried out at the manufacturer's factory.

Attachments: - Electrical and hydraulic diagrams and bills of materials.
Other technical documents are sometimes supplied with Vulcatherm®:
Manual for the main components (motor pump system, power unit,temperature regulator...), commercial specification, factory exit inspection sheet...
These additional documents do not form part of the present contractual operating manual. They are reserved to specialised technicians acting by delegation and under the control of VULCANIC. They are thus worded in the French and English languages, in accordance with harmonised European Directive 89/392 of 14 June 1989 with its latest modifications.