

1. ***Operation overview***
2. ***Advance and Hold operation***
3. ***Delta T operation***
4. ***Casing control***
5. ***Set Up (Changing the way the instrument works)***
6. ***Factory default settings***
7. ***Alarms***
8. ***Cooling control***
9. ***Trouble Shooting***
10. ***Connections***
11. ***Calibration***
12. ***Compatibility with previous versions***
13. ***Aqua-Stat pulsing rates***

ENERCORP instruments ltd

25 Shorncliffe Road,
Toronto, Ontario, Canada
M9B 3S4

www.enercorp.com
sales@enercorp.com
(416)231-5335

1. OVERVIEW

The DCS-3000 tobacco curing system has been designed to automatically control the temperature and humidity during the complete tobacco curing process. At all times the operator has a clear indication of the operating conditions within the tobacco kiln.

The system can operate using the *Advance & Hold* method or the *Delta "T"* method. The *delta "T"* method requires an extra temperature sensor, new instrument faceplate and different software. This option must be specified at ordering time. Installed Advance and Hold versions can be converted to delta "T" versions for a modest charge.

Once curing is complete the DCS-3000 can be used to control the casing process.

ADVANCE AND HOLD METHOD

This curing technique has been in wide spread and successful use for many years with mechanical clockwork advance mechanisms and filled systems thermostats. The DCS-3000™ gives the farmer the same ease of use but gives him better and more repeatable control over the curing process.

- Both the wet and dry bulb readings can be displayed accurately to the nearest degree.
- The advance rate is precisely controlled to the nearest 1/2 degree Fahrenheit
- The wet bulb can be accurately controlled with the auto damper option.
- The starting temperatures are reset at the end of each cure to minimise accidents

DELTA "T" METHOD

The promise of the Delta "T" technique is that it can cure tobacco almost automatically with very little operator attention. In this technique the fan runs continuously but the furnace fires only when the temperature difference between the top and bottom of the kiln is less than a specified amount. Initially with very wet, tightly packed tobacco the kiln temperature will advance slowly. As the tobacco dries the furnace will fire longer and the kiln temperature will advance faster. In theory the tobacco should cure faster and more uniformly with less operator interaction.

- Two step process, the first is yellowing and the second is drying.
- The wet bulb is controlled automatically
- The advance rate is determined automatically.
- Little operator intervention except at yellowing stage

CASING

The operator can choose the default values or specify the dry and wet bulb temperatures and the duration of casing. The DCS-3000 will then control the casing process.

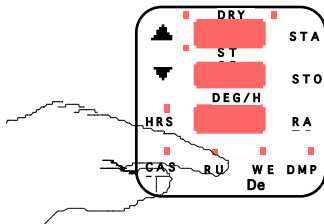
2. ADVANCE & HOLD OPERATION

STAND-BY

As long as power is applied to the DCS-3000 the dry bulb temperature of the kiln is indicated on the upper display. If the other displays are blank the unit is NOT controlling the kiln and is said to be in stand-by mode.

TO BEGIN A CURE CYCLE

Press and hold the RUN button for 5 seconds until the light above this button remains on. This time delay is intentional to prevent a cure cycle beginning accidentally. Once a cure cycle is started it can be stopped by pressing the same RUN button for 5 seconds. Again this time delay prevents the cure from being accidentally stopped.

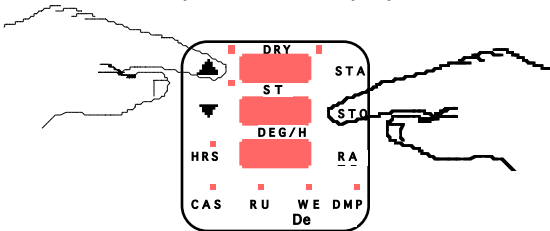


While the unit operates, the light in the RUN button remains lit, the dry bulb temperature, stop temperature and degrees per hour displays remain on. A START temperature of 70F, STOP temperature of 90F and DEG/HR rate of 1.0 are automatically set by the instrument when it is started by pressing RUN for 5 seconds. These values can be easily changed as described later.

The unit will control and ramp the kiln temperature from the START to the STOP temperature at the rate specified and hold it there. It will ramp either up or down.

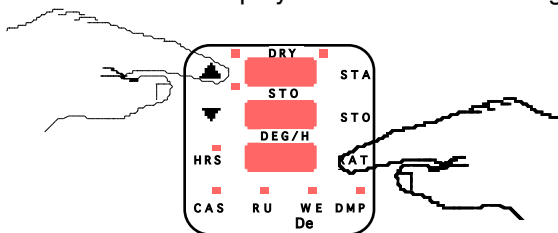
TO CHANGE TEMPERATURE

To progress to each new curing stage hold the "STOP" button down and at the same time press an arrow key until the desired new STOP temperature is displayed.



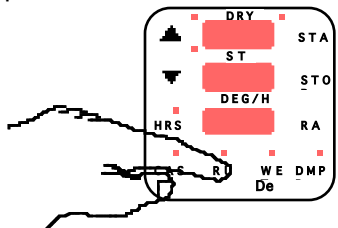
TO CHANGE RATE

To change the ramping rate hold down the "RATE" key and at the same time press the UP or DOWN arrow keys until the desired new RATE is displayed. The rate will change in 1/2 degree Fahrenheit increments.



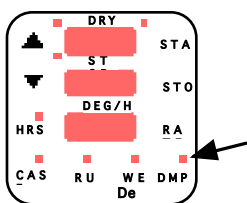
TO STOP A CURE CYCLE

When the cure is complete press and hold the RUN button for 5 seconds until the light in this button turns off, this will reset the START temperature to 70F, the STOP to 90F and the RATE to 1 degree per hour. Do not use the toggle switch on the right of the instrument to power off at the end of a cure. If you do this the instrument will think there has just been a power failure and could restart with a set point of 155F and ruin a kiln of tobacco.

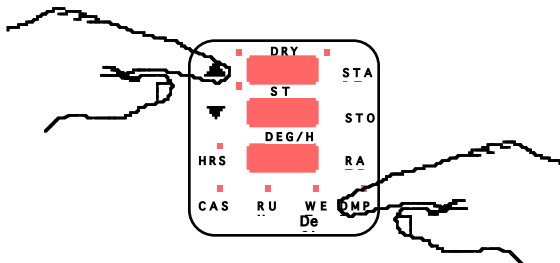


DAMPER OPERATION

If *auto damper* is active the LED beside the DAMPR button will wink on and off at 2 second intervals.



The wet bulb set point is automatically set to 100F when a cure is started. It is indicated on the middle display when you press and hold the "DAMP" button. You can change its value by holding DAMPR and within 8 seconds pressing either arrow key.

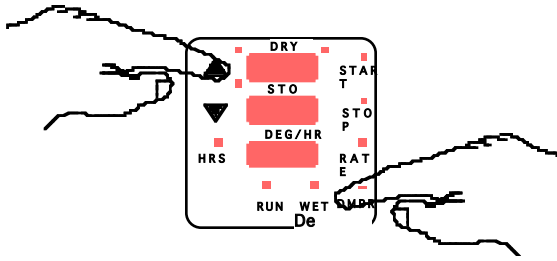


If the actual wet bulb temperature is below the set point the damper will remain closed. As soon as the wet bulb temperature exceeds the set point the damper will begin to open gradually until it is fully open when the actual temperature reaches the set point plus 2 1/2 degrees.

If the wet bulb exceeds 2 1/2 degrees above the set point the advance will stop and hold the dry bulb at its current temperature with the damper fully open to allow moisture to be exhausted from the kiln.

The bottom readout which displays the advance rate will begin to flash to indicate that the dry bulb temperature is being held constant and not advancing.

Manual Operation: If your kiln has an automatic damper motor installed but has been set for manual damper control you can operate the damper from the DCS-3000. Press and hold the "DAMP" button, and at the same time press the up or down arrow key. The bottom display will change between 0 and 100% to indicate the damper opening.



Switching between auto & manual

You can change between auto and manual by pressing and holding the DAMPR button for 10 seconds. The middle green display will change to either YES or NO to indicate that auto damper is on or off. Continue to hold the DAMPR button and press either arrow key to change damper function. If you change to auto damper the wet bulb set point will be set to 100F. If you change to manual the damper will be set to 20% open. Release the DAMPR button and press it again to change the set point with the arrow keys if desired.

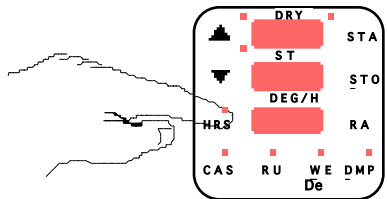
Some growers like to use automatic damper control until colour fixing is complete and then proceed with manual damper control. This feature permits changing from auto to manual operation in 10 seconds without affecting any of the setpoints.

FAN MOTOR ENERGY SAVING OPERATION

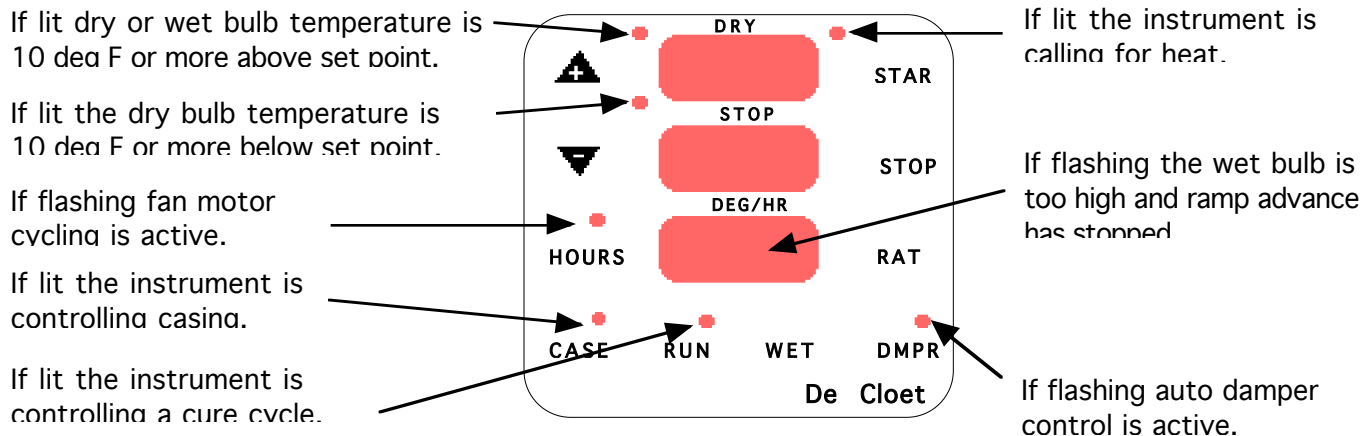
At certain times during the curing process tobacco will cure properly without a continuous forced air supply. If the farmer wishes he can cycle the fan motor on and off at these times to save energy. The cycle rate is set in SET UP mode. The factory default setting disables cycling. You must specify a cycle rate in SET UP mode if you wish to use this feature. While in RUN mode you can turn cycling on or off at any time.

Switching cycling on and off

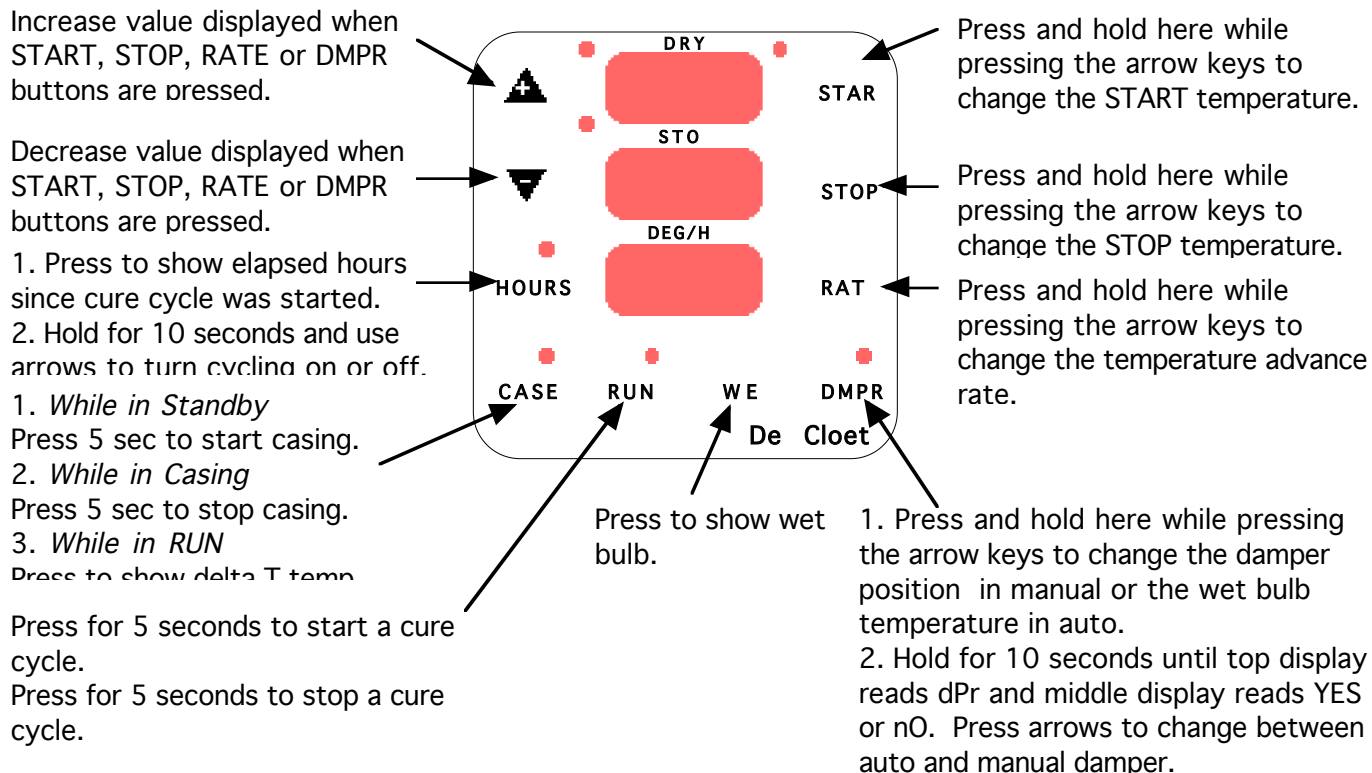
You can switch cycling on and off by pressing and holding the HOUR button for 10 seconds. The top display will read CYL and the middle green display will change to either YES or NO to indicate that cycling is on or off. Continue to hold the HOUR button and press either arrow key to turn cycling on or off. While cycling is active the LED in the HOUR button will flash every two seconds.



WHAT THE ADVANCE AND HOLD KEYBOARD LIGHTS MEAN



WHAT THE BUTTONS DO

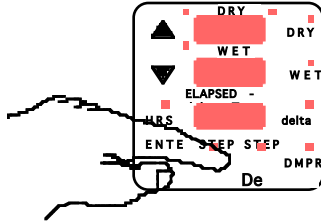


4. DELTA 'T' OPERATION

STAND-BY

As long as power is applied to the DCS-3000 the dry bulb temperature of the kiln is indicated on the upper display. If the other displays are blank the unit is NOT controlling the kiln and is said to be in stand-by mode.

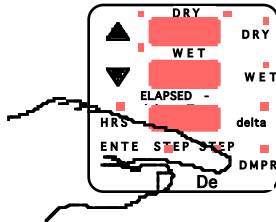
YELLOWING



Press the STEP1 button for about 5 seconds until the light in this button remains on. While the unit operates the light in the STEP 1 button remains lit, the actual dry bulb temperature, the actual wet bulb temperature and the elapsed time displays will be on. The elapsed time counter is set to zero when STEP 1 is pressed. Use the set point keys to change the factory values if desired.

The unit will call for heat if the actual dry bulb temperature minus the delta T temperature is less than the delta T setpoint for STEP 1 and the dry bulb temperature is less than the DRY setpoint for STEP 1.

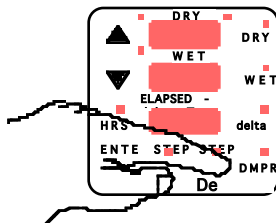
DRYING



When you are happy the conditions are right and the yellowing process is complete press the STEP 2 button. The STEP1 light will go off, the STEP2 light will turn on, the dry bulb temperature, wet bulb temperature and elapsed time displays will be on. Use the set point keys to change the factory values if desired.

The unit will call for heat if the actual dry bulb temperature minus the delta T temperature is less than the delta T setpoint for STEP 2 and the dry bulb temperature is less than the DRY setpoint for STEP 2.

STOPPING THE CURE



At the end of the cure press STEP2 for about 5 seconds until the red light goes out. This will reset the clock, so that you are ready for the next cure.

SET POINT KEYS

There are set point keys, labelled DRY, WET, delta T to easily view and change any individual set point. While the program is running depress any set point key to display the set point value.

To change the value, keep the key depressed and use the arrow keys to select the desired value. The program is now updated. Pressing the DAMPR key will display the damper percent opening. This can not be changed.

In delta T operation the 10 degree alarm works as a high alarm. It does not monitor low temperatures.

The DCS-3000 is delivered preprogrammed with the following values.

YELLOWING STAGE

dry bulb set point 100F
wet bulb set point 100F
delta T set point 5 degs F

DRYING STAGE

dry bulb set point 155F
wet bulb set point 100F
delta T set point 15 degs F

Any changes to these values entered by the operator during one cure will be remembered by the instrument and used by it as the default values for the next cure.

AUTO DAMPER CONTROL

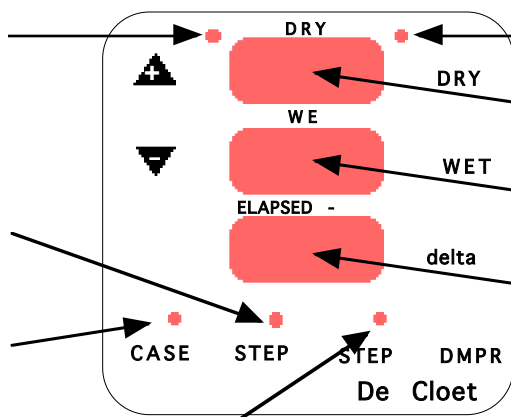
Auto damper control is active at all times in delta "T" mode.

WHAT THE DELTA "T" KEYBOARD LIGHTS MEAN

If lit the dry or wet bulb temperature is 10 deg Fahrenheit or more above the set point.

If lit the instrument is controlling STEP1 of a cure cycle.

If lit the instrument is controlling the casing process.



If lit the instrument is calling for heat.
 Dry bulb temperature, Setpoint when DRY pressed
 Wet bulb temperature' Setpoint when WET pressed
 This display normally indicates elapsed hours . It indicates the delta T setpoint when the delta T button is depressed. It indicates delta T actual when CASE is pressed

If lit the instrument is controlling STEP2 of a cure cycle.

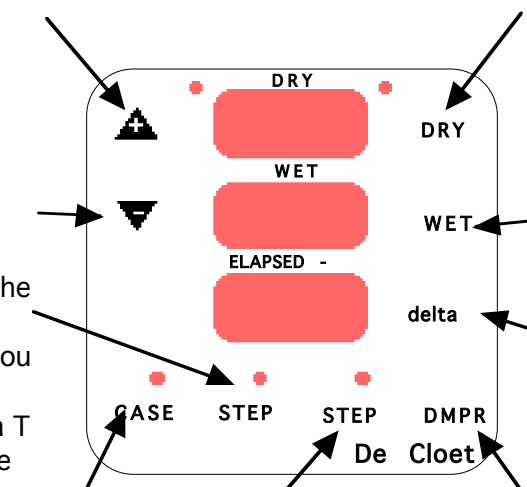
WHAT THE BUTTONS DO

Increase value displayed when DRY, WET, RATE or DMPR buttons are pressed

Decrease value displayed when DRY, WET, RATE or DMPR buttons are pressed

Press STEP1 to start a cure. The DCS-3000 remembers the setpoints from the last cure. You can check the setpoints by pressing the DRY, WET or delta T keys. This step will control the cure up to the following stage

1. *While in Standby*
Press 5 sec to start casing.
2. *While in Casing*
Press 5 sec to stop casing.
3. *While in STEP1 or STEP2*
Press for temperature of delta T sensor



Press and hold here while pressing the arrow keys to change the DRY temperature setpoint

Press and hold here while pressing the arrow keys to change the WET temperature setpoint

Press and hold here while pressing the arrow keys to change the delta T temperature setpoint

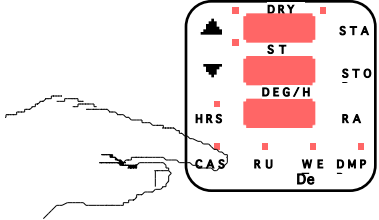
Press STEP2 to complete a cure. The DCS-3000 remembers the setpoints from the last cure. You can check the setpoints by pressing the four keys on the right side. This step will control the cure from following to

Press and hold here to see the damper position displayed in the bottom display

4. Casing

TO BEGIN CASING

Press and hold the CASE button for 5 seconds until the light above this button remains on. This time delay is intentional to prevent casing beginning accidentally. Once a casing cycle is started it can be stopped by pressing the same CASE button for 5 seconds. Again this time delay prevents casing from being accidentally stopped.



While the unit operates, the light in the CASE button remains lit, the upper display indicates the dry bulb, the middle display indicates the wet bulb and the lower display counts down the time remaining in the casing cycle. A dry bulb temperature of 122F and wet bulb temperature of 113F are automatically set by the instrument when the CASE key is used the first time. These values can be easily changed and the instrument will remember and use the most recent values when starting the next casing cycle.

An elapsed time of 8 hours will be set by the DCS-3000 each time a casing cycle is started. This duration can be changed for the current cycle. The new value will not be stored for future cycles.

When the CASING cycle is started:

- the humidity relay is deactivated
- the 10 degree dry bulb window alarm is deactivated
- the fan will turn on
- the furnace relay will operate as required to reach the dry bulb setpoint
- if the actual dry bulb temperature is greater than the dry bulb setpoint.
 - the damper will open fully
- if the actual dry bulb temperature is less than the dry bulb setpoint.
 - the damper will close fully

When the actual dry bulb temperature reaches its setpoint

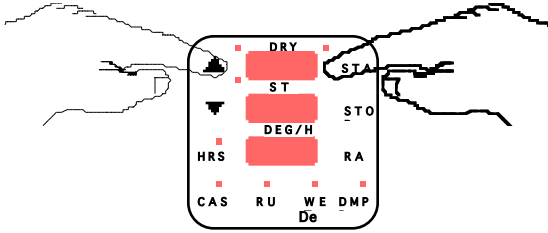
- the damper will close fully
- the 10 degree dry bulb window alarm is activated
- the humidification relay will maintain a wet bulb of 113F or the value specified by the operator by closing the normally open humidity relay when the wet bulb temperature drops below its setpoint.
- the gas valve will be controlled to maintain the dry bulb setpoint.
- the dry and wet bulb temperatures will be held at their setpoints for 8 hours or for as long as specified by the operator.

When the timer counts down to 0

- the damper will open
- the fan will run for one hour and then shut off
- the burner, humidity and 10 degree alarm relays will be de-activated
- the timer will continue to count down until the CASE button is held down for 5 seconds

TO CHANGE CASING DRY BULB TEMPERATURE

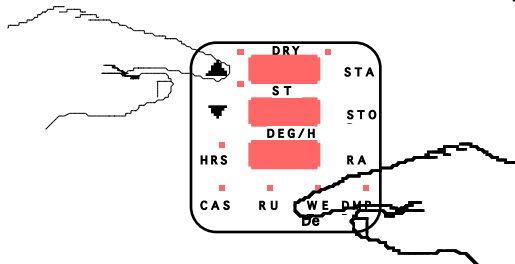
Hold the "START" button down and at the same time press an arrow key until the desired new temperature is displayed.



TO CHANGE CASING WET BULB TEMPERATURE

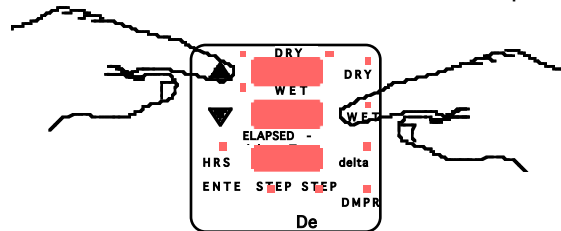
If operating in advance and hold

Hold the "WET" button down and at the same time press an arrow key until the desired new temperature is displayed.



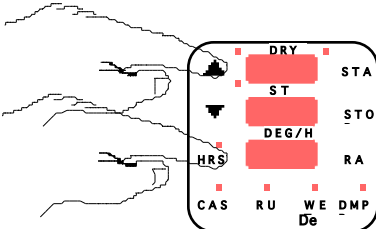
If operating in delta T

Hold the "WET" button down and at the same time press an arrow key until the desired new temperature is displayed.



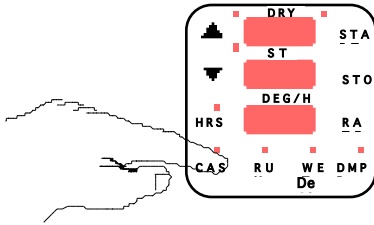
TO CHANGE CASING DURATION

Hold the "HOUR" button down and at the same time press an arrow key until the desired new time is displayed.



TO STOP A CASING CYCLE

Hold the CASE button for 5 seconds until the light in this button turns off.



NOTE 1: The DCS-3000 remembers casing set points from run to run and uses the last values as the default.

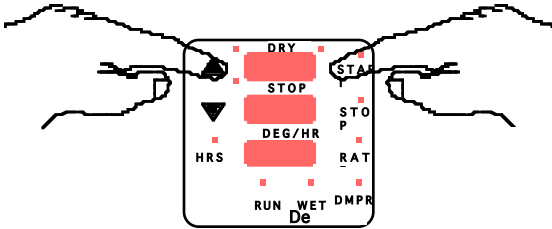
NOTE 2: The casing humidity relay will call for humidity during RUN mode when the actual wet bulb drops below setpoint. This will only have an effect if a water supply and the casing wand are connected.

5. SET-UP (Changing the way the instrument works)

The DCS-3000 is normally delivered preprogrammed and you will not need to use this section. If you want to change how the DCS-3000 operates these instructions tell you how to:

- Specify how many seconds to wait before starting the fan motor after a power failure
- Specify on/off cycle rate for fan motor energy saving
- Specify the minimum starting temperature you can set in run mode
- Set an identification number for the instrument if using the communications features
- Set a correction to the pulsing rate
- Apply temperature correction to the RTD temperature sensors

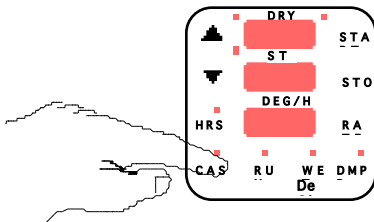
Press and hold the UP arrow and START keys for 10 seconds



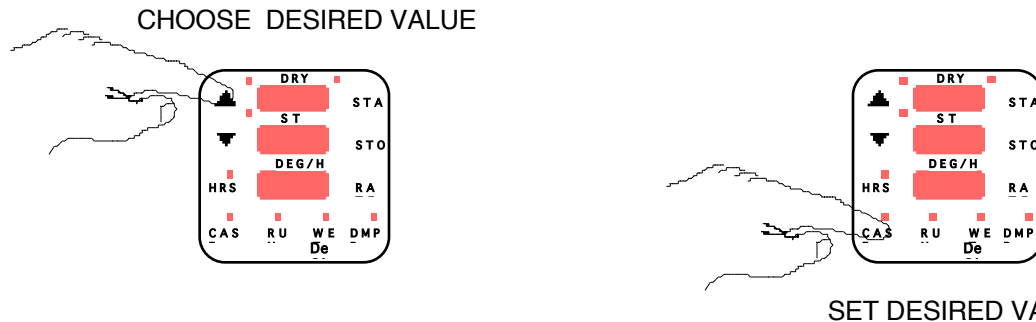
Software identification: After 10 seconds has elapsed and as long as you continue to hold the two keys the top display will read 98 and the middle display will read r0x. This indicates the version of the software which is installed. This information is helpful to our technicians.

Display check: Once you release the keys all displays will cycle continuously through the numbers 9 to 0. This is used to verify all display segments are operating properly. Once you are happy all display segments are operational

Press the key in the lower left corner



Choose fan motor startup time delay:

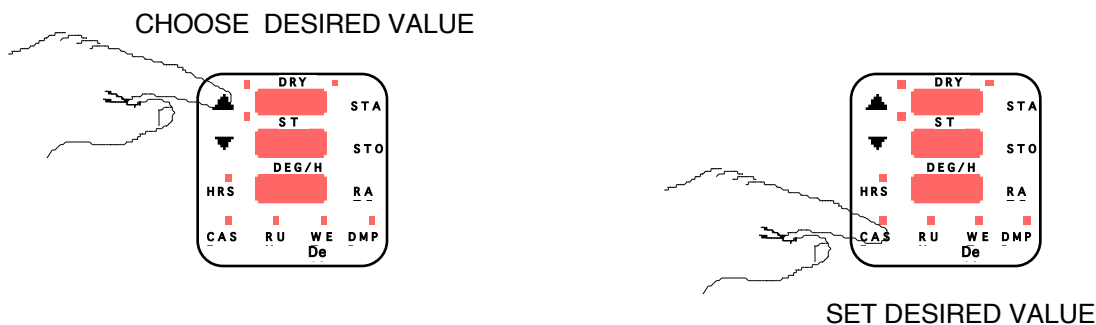


To prevent circuit over loads when starting several kilns on the same power line after a power failure a time delay can be programmed to stagger the starts of individual kilns.

The top display shows “dLY” and the middle display flashes. Choose the desired value with the arrow keys. Press the lower left unmarked key to set this value. This delay only applies to start after a power failure. On manual start the fan will start immediately.

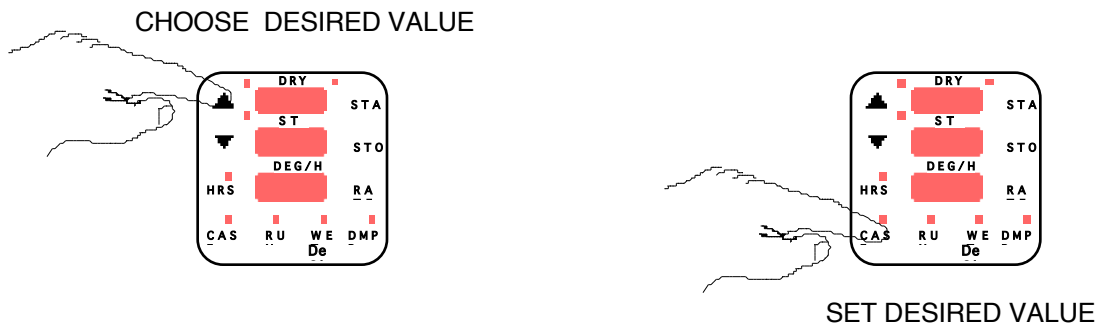
If you do not have the multi-function board set this value to zero since the instrument will prevent the furnace from firing until the set time has elapsed.

Choose start of operating range:



The top display shows “Str” and the middle display flashes a number from 32 to 112. Choose the desired value with the arrow keys. Press the lower left unmarked key to set this value. The operating range will always be 100 Fahrenheit degrees. It will normally be from 70 to 170. Optionally it may be changed to say 35 to 135 for Ginseng drying or 100 to 200 for drying peppers.

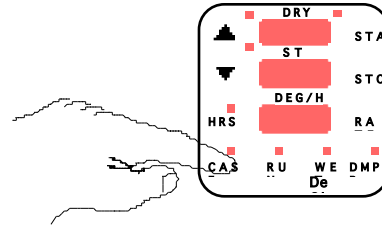
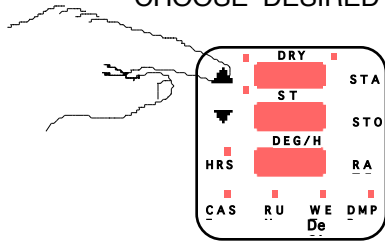
Choose instrument ID:



If several DCS-3000's are connected to a computer you will need to uniquely identify each DCS-3000. In SETUP mode a 3 digit identification number can be assigned to each DCS-3000. The top display will read 1d, meaning identification. Choose the desired value with the arrow keys. Press the lower left unmarked key to set this value.

Changing the Aqua-Stat pulse rate

CHOOSE DESIRED VALUE

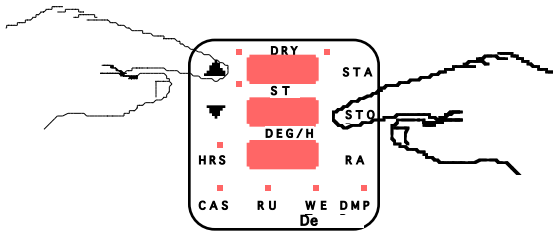


SET DESIRED VALUE

It is no longer necessary to manually adjust a knob on the front of the Aqua-Stat. The Aqua-Stat pulse rate is controlled by the DCS-3000 and automatically pulses faster as the temperature increases in the kiln. However, if the default value of 100 is either too slow and the wet bulb dries out or is too fast and the water reservoir empties too quickly the rate can be changed here. The default set at the factory is 100%. You can adjust this value in 1% increments down to 50% causing the time between pulses to be 1/2. This will increase the amount of water going to the wet bulb if it dries out too quickly. You can also adjust this value in 1% increments up to 200% which will double the time between pulses and use water less quickly.

The top display will read AqA for Aqua-Stat. The bottom display will read a value from 50 to 200. Press either arrow key to choose the value you want. When the desired value is displayed press the lower left key to set the value.

Apply temperature correction:



The displayed temperature of each of the three RTD sensors can be offset here by up to plus or minus three degrees Fahrenheit. Hold the button to the right of the display to be offset and use the arrow keys to apply a correction. **Please note** that this correction is always in Fahrenheit whether or not the instrument is set to display Celcius or Fahrenheit. If the instrument is set for Celcius readout a correction of +1 will display as a correction of 5/9 degree Celcius.

6. DEFAULT VALUES

The standard unit will be delivered preprogrammed and ready for operation with the following variables preset.

- Temperature displays will be in Fahrenheit
- The temperature control switching differential will be set to 0.7 degrees
- The minimum set point, SPL, will be set to 70
- The unit will be set for advance and hold mode
- The motor start time delay will be set to 0 seconds
- The instrument ID will be set to 000
- The fan motor cycle time will be set to 10
- The fan motor cycling will be set to off

- The delta T STEP1 dry bulb will be set to 100F
- The delta T STEP1 wet bulb will be set to 100F
- The delta T STEP1 differential will be set to 5F
- The delta T STEP2 dry bulb will be set to 155F
- The delta T STEP2 wet bulb will be set to 100F
- The delta T STEP2 differential will be set to 15F

- The casing dry bulb temperature will be set to 122F
- The casing wet bulb temperature will be set to 113F
- The casing time will be set to 8 hours

7. ALARMS

The following alarms will be active while the unit is in RUN.

1. High/Low alarm - if the actual dry bulb temperature is 10 degrees below or either the wet or dry bulb is 10 degrees above its set point an alarm relay will be closed. This relay can be wired into an external annunciator.
2. LED's to the left of the dry bulb display indicate a high or low temperature alarm.

8. COOLING

A kiln may be used to condition or cure products such as ginseng which may require cooling rather than heating. In order to facilitate such products the control relays are double throw and the STOP set point may be set below the START set point so the the temperature may be ramped down as well as up.

9. TROUBLE SHOOTING

The unit will not power up if:

- The air pressure switch does not detect the fan running.
- The on/off toggle switch on the right of the instrument is in the OFF position

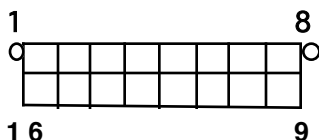
The unit will not call for heat if:

- The high alarm temperature is 10 degrees F or more above the dry bulb set point.
- The high alarm temperature is above its set point which can be set to 150,200 or 250F. In this case the relay will latch open and can be reset by pushing the button inside the instrument once the temperature has dropped.

The unit will not advance

- If you have auto damper active and the wet bulb temperature is 2 1/2 or more degrees above the wet bulb set point in ramp and hold mode. If the unit is in manual damper mode this feature is not active.
- If the rate (deg/hr) is set to 0, or the START temperature set point is equal to the STOP set point.

10. CONNECTIONS



The above view is from the back of the DCS-3000-A controller

1. 24 VAC1
2. Ground
3. +5V for comms
4. Gas valve (N.O.)
5. Gas valve common
6. Gas valve (N.C.)
7. Alarm relay common
8. Damper output (2-10 VDC)
9. Temperature Setpoint
10. Alarm relay (N.C.)
11. Alarm relay (N.O.)
12. Humidification control
13. Comms receive
14. Comms Transmit
15. Fan control
16. 24 VAC2

If you power the TC-1250 without its mating DCS-2050 multi-function board you should obtain a 48 volt transformer with centre tap. Connect the centre tap to terminal 2 and connect one of the remaining leads on the transformer to terminal 1 and the other to terminal 16. If you have only a pre-installed 26.5 volt transformer connect the leads to terminals 1 and 2.

11. CALIBRATION

Changes in calibration up to 3 degrees Fahrenheit are described in the *SET-UP* section under the heading *apply temperature correction*.

If a larger correction is required the temperature sensors should first be checked. If it is determined that the sensors are good then the DCS-3000 can be recalibrated using a calibration box available from the factory.

Calibration using factory supplied calibration box

- Note: It is NOT necessary to disconnect the RTD temperature sensors when performing a calibration as it was with older models
- Put the DCS-3000 in stand-by mode (only the top readout is lit)
- Plug the calibration box cable into the mating connector on the back of the DCS-3000
- Move the toggle switch to the 32 position
- Press the black button
- Press the down arrow key on the DCS-3000
- Move the toggle switch to the 170 position
- Press the up arrow key on the DCS-3000
- Disconnect the calibration box
- The DCS-3000 is now re-calibrated

12. COMPATIBILITY WITH PREVIOUS YEARS

- **1997** and earlier versions can not be upgraded to add new features.
- **1998** through 2001 front boards are hardware interchangeable. They require the a software version of 101 R06 or higher to support Aqua-Stat pulsing.
- **1998** through 2000 multi-function “back” boards are interchangeable
- **2001** multi-function boards labeled DCS-2050 REV6 or higher are not compatible with earlier versions.

1998 introduced the following features.

REMOTE CONTROL (this feature requires multi-function board)

DCS-3000 systems can be upgraded to a version with communication. This enables a tobacco kiln to be monitored and controlled remotely over a telephone line with the farmer’s own computer when the available software and hardware module are added.

- Software allows a farmer to see an overview of up to 253 kilns in one yard. Kilns requiring action are highlighted to draw the operator’s attention. The farmer can select a particular kiln and see on his computer screen the status of that kiln. He can then change the status of that kiln.
- A new hardware interface unit, the DCS-IU, connects up to 253 kilns to one telephone line.
- The farmer requires his own PC and modem to connect with the system.

CASING (this feature requires multi-function board)

The DCS-3000 can now be used to control casing with the addition of a new “CASE” control button and a new humidification relay. The farmer will be able to set the time as well as the dry and wet bulb temperatures for casing.

ENERGY SAVING FAN MOTOR CONTROL (this feature requires multi-function board)

During certain stages of the curing process it is possible to save energy by turning the fan on and off for a period of time. The farmer can select this operating mode any time while in RUN mode. Cycle rates can be set between 10 and 60 minutes.

START UP TIME DELAY (this feature requires multi-function board)

The timer function is now built into the DCS-3000 micro-processor. In set up mode the user will be asked to set a time delay between 0 and 999 seconds in 1 second intervals. This will allow kilns to have staggered starts. A control relay and terminal is provided on the multi-function board.

WET BULB ALARM

If auto damper is active a wet bulb temperature 10 degrees or more above set point will also trigger the alarm relay now activated when the dry bulb is 10 degrees outside its set point.

FIELD CALIBRATION OF TEMPERATURE SENSORS

Temperature sensors, when held at the same temperature, should agree with each other within one degree Fahrenheit. In the event they do not a new setup procedure allows an offset of up to three degrees Fahrenheit to be programmed.

1999 Several upgrades to software were made to support the De Cloet alarm system and remote PC monitoring and control. No significant hardware changes were made. 1998 and 1999 versions can be upgraded to the latest software.

2000 casing relay increased to 30 AMPs to directly power an electric motor.

2001 Aqua-Stat pulsing control added. Communications hardware incorporated in multi-function board without need for plug-in module.

2002 Multi-layer controller PCB, shielded harness and software changes for improved reliability. Improved housing.

13. AQUA-STAT PULSING RATES

The DCS-3000 increases the Aqua-stat pulsing rate as the actual dry bulb temperature increases according to the following table. The table is for the factory default setting 100 for the AQA parameter in set-up. The time between pulses can be decreased by decreasing the setting value and increased by increasing the value.

Temperature Degrees Fahrenheit	Seconds Between Pulses
70	91
73	85
76	79
80	74
83	69
86	64
89	56
92	52
95	48
99	44
102	40
105	37
108	34
111	31
115	29
118	26
121	23
124	20
127	17
130	14
134	12
137	10
140	8
143	6
146 up	4