EXTREMELY ACCESSIBLE COOKSTOVE TRACKING
EXACT SENSOR
USER MANUAL

EXACT SENSOR SPECIFICATIONS

Type of stoves: all

Maximum number of logs: 178,560 (or 22,320 if temperature is logged)

Measurement frequency: 1 minute

Log frequency: 1-30 minute

Battery life: 4+ years of usage (8 years of self-life)

Measurement technology: Infra-Red (contactless)

Launch and data transfer: wireless touch screen launcher, download data on micro SD card

Protection: Sensor are completely water and dust proof.

INTRODUCTION

The EXACT Sensor has been designed from the ground up to be an **EX**tremely **A**ccessible **C**ookstove **T**racking System. Each sensor is small and rugged (water and dust proof). A handheld launcher is used to start and stop the sensors. This launcher communicates wirelessly with the sensor.

We designed this product with the reality of stove stacking in mind: each mission is managed at the household level and multiple sensors placed on multiple stoves are launched and stopped simultaneously.
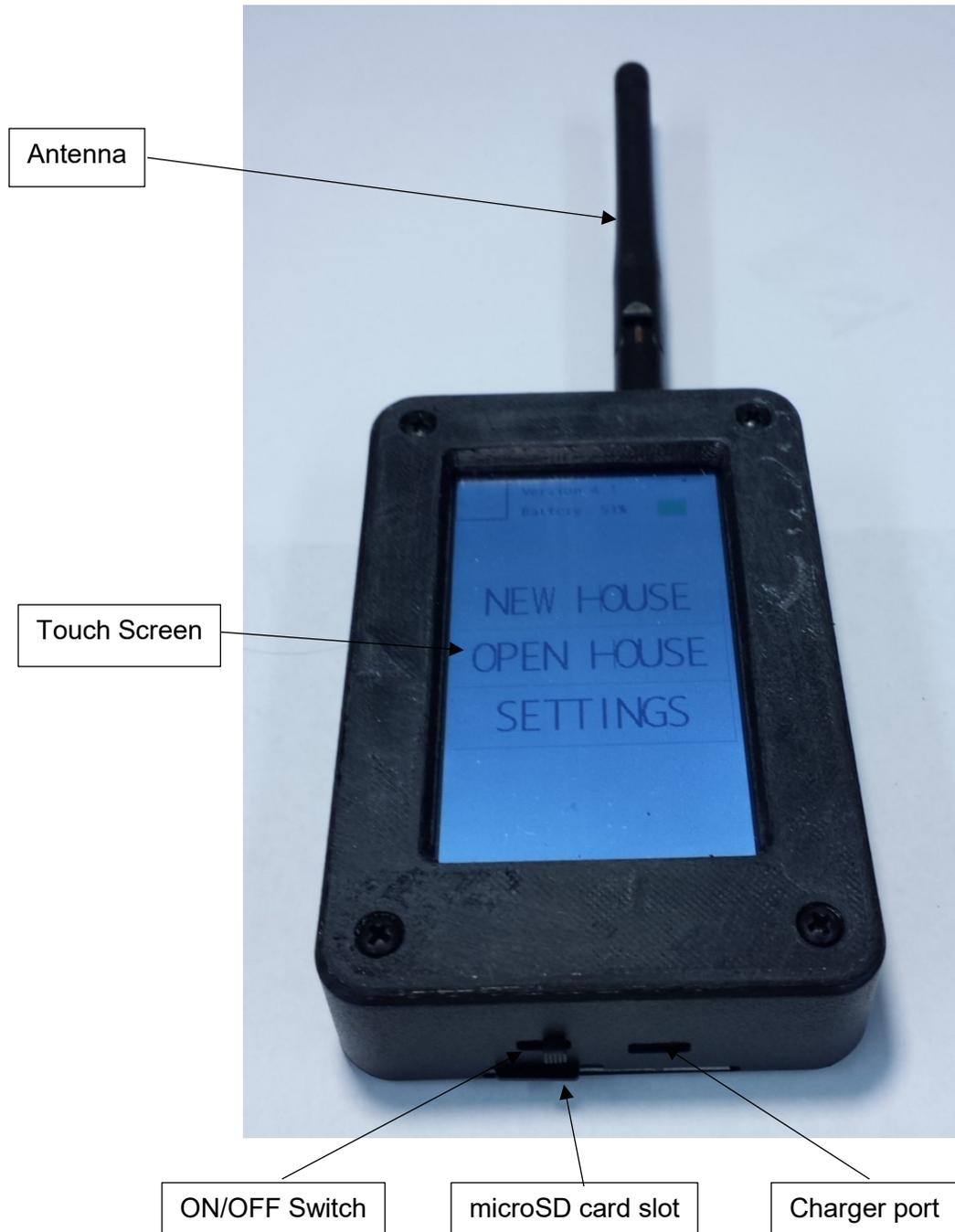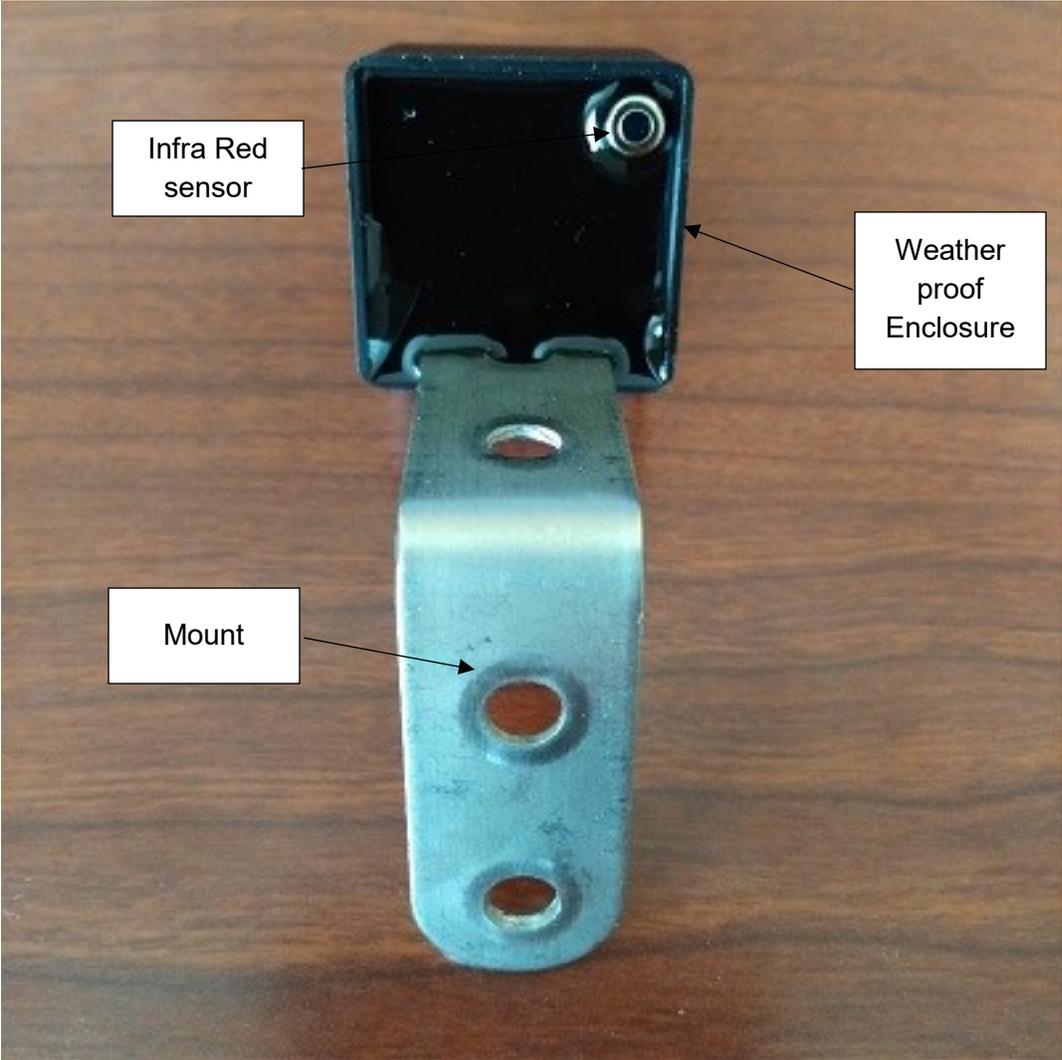The data from the multiple sensors is gathered directly into one file, making the analysis easier.

While our sensors can measure and log temperature like most SUMS loggers do, their real added value is that they can also directly detect and log whether the stove is being used or not. The EXACT sensors count cooking events and measure cooking time on-the-fly!

When the data is being downloaded in the household, a summary of up to 5 stoves is displayed (with the number of daily cooking events, daily cooking time and date of last use). This quantitative data is instantly available as one enters the household. This allow the surveyor to build upon it and to collect more qualitative data and explanations from the cook about the different usage patterns. All the meta-data is input in the field (stove type, household number, study arm) during deployment.

LAUNCHER DESCRIPTION

Antenna

Touch Screen

ON/OFF Switch

microSD card slot

Charger port

SENSOR DESCRIPTION

Infra Red sensor

Weather proof Enclosure

Mount

LAUNCHING THE SENSORS IN A NEW HOUSEHOLD

- Press the NEW HOUSE button on the launcher. This will scan for all the sensors in the surroundings.
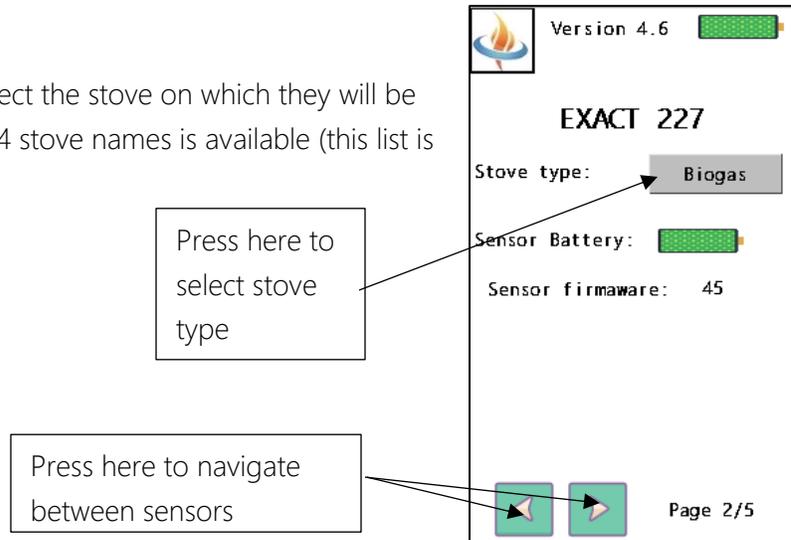
Press "NEW HOUSE"

N.B: If you are carrying a lot of sensors with you, you should keep the unused sensors in the transport box provided. This box is designed to prevent communication with the launcher.

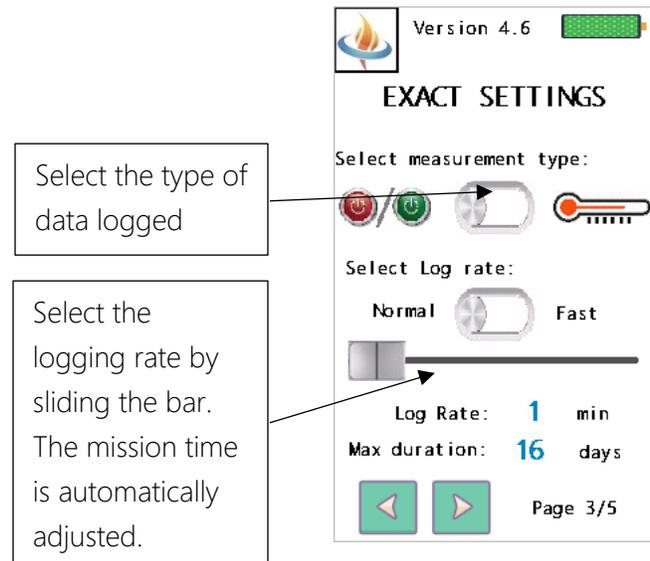- Select then the sensors you want to add to this household.

N.B: the launcher can list up to 16 sensors. If there are more than 16 sensors around, they will not be all listed. Keep the sensors you don't want to launch inside the carry box.
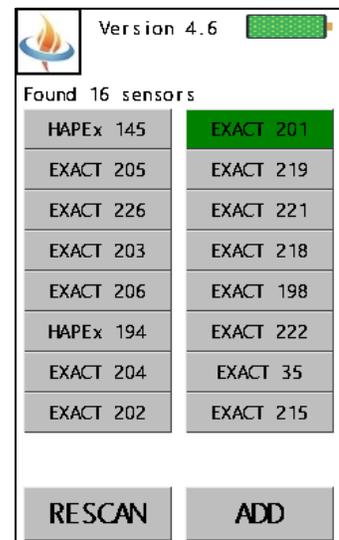
- For each sensor selected, select the stove on which they will be placed. A predefined list of 14 stove names is available (this list is customizable, see below).

Version 4.6

EXACT 227

Stove type: Biogas

Sensor Battery:

Sensor firmaware: 45

Press here to select stove type

Press here to navigate between sensors

Page 2/5

- You should decide whether you want to log only whether the stove is used or also the actual temperature of the stove.
- Select then the log rate, this will determine how long the mission can last before the memory is full, make sure to leave some room here.

Select the type of data logged

Select the logging rate by sliding the bar. The mission time is automatically adjusted.

Version 4.6

EXACT SETTINGS

Select measurement type:

Select Log rate:

Normal   Fast

Log Rate: 1 min
Max duration: 16 days

Page 3/5

N.B: The "fast" mode is a special mode that is useful to do sensor placement testing. In this mode, the sensor will log the temperature every 4 seconds. It is then easy to see in real time how the placement of sensor influences the sensitivity of the temperature recorded. In this mode though, the internal memory will be full in 24 hours, so it is not very useful for long term deployment.
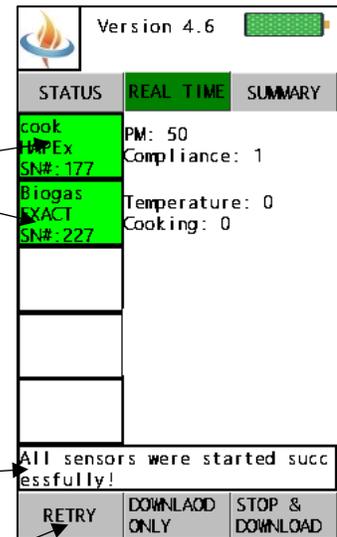
- Provide then the information for the household: household #, study arm (control/intervention).

Select the study arm in which the household is.
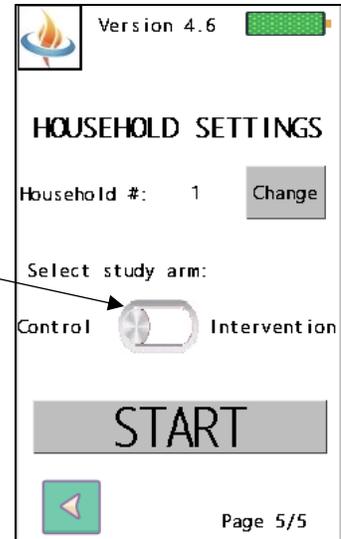
- Then press "START". You will receive a confirmation that each sensor has been started successfully (they turn green).

The name of the sensor turns green when it is successfully launched

If for some reason some sensors have not been started successfully, press the retry button until they have all succeeded.

A summary of the action taken is displayed here

Press the "RETRY" button to execute again the latest action

N.B: when you start a new mission, the sensor reset them-self and all the data from the previous mission is erased. So be sure to download the data you need from the sensor before you start a new mission.

OPEN EXISTING HOUSEHOLD

- Make sure a SD card is inserted into the launcher
- Press the OPEN HOUSE button

Press "OPEN HOUSE"

Version 4.6

NEW HOUSE
OPEN HOUSE
SETTINGS
CALIBRATION
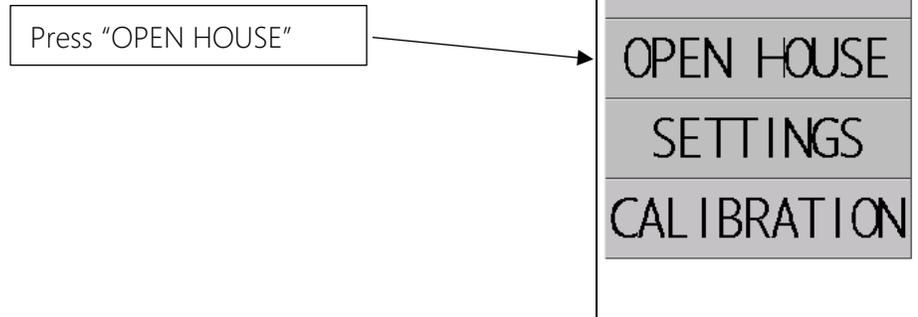
- After a 15 second scan the household numbers stored in the sensors in the surroundings will be displayed.
- Choose the household number you want to OPEN.

Press on the household number you want to OPEN

Version 4.1
Battery: 100%
Found 3 households

Select household:

0	5
1	

RESCAN
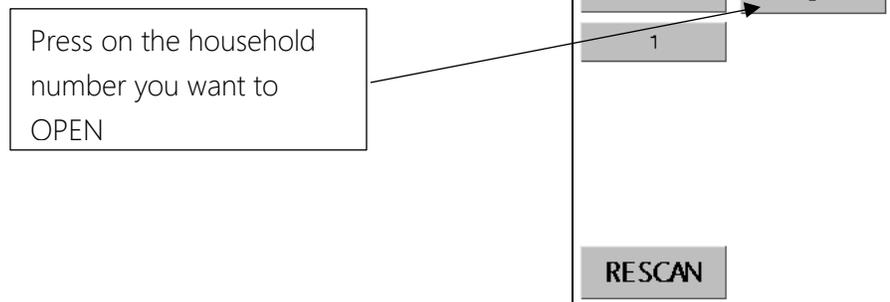
- You will see a summary of up to 5 sensors present in this household. At the top you have three options:

○ STATUS: shows if the sensors are active or not and display their battery level and their memory level (a sensor automatically stops when its memory is full)

○ REAL TIME: shows the current temperature and whether the sensors detect cooking or not.

N.B: the sensor always measures the difference between stove temperature and ambient temperature in degree Celsius.

○ SUMMARY: shows a summary of the cooking event per day (except when the sensor has been running for less than one day in which case is display the total number of cooking event), the cooking time in minute per day (except if the sensor has been running for less than one day) and the day the stove was last used.

At the bottom, you have two options:

　　　　○ DOWNLOAD ONLY if you want download the data but keep the sensors to running.

　　　　○ *STOP & DOWNLOAD* if you want to download the data and stop the sensors as well.

● When the box turns green that means that the sensor data has been downloaded successfully.
● If some of the download have not been successful then press the RETRY button
● Once the data from all the sensor have been downloaded, the launcher combine all the data into one file, please don't turn off the launcher during this operation.

TRANSPORT BOX

Transport box provided with the sensor is made of metal and prevent the communication with the launcher. Just take out of the box the sensors you want to launch. Leave the other sensors inside the box and close the lid to prevent any communication with the sensors that you don't want to start.

SETTINGS

You change the settings by pressing the "SETTINGS" button on the home screen.
You can then, choose between the "time settings" and the "sensor settings"
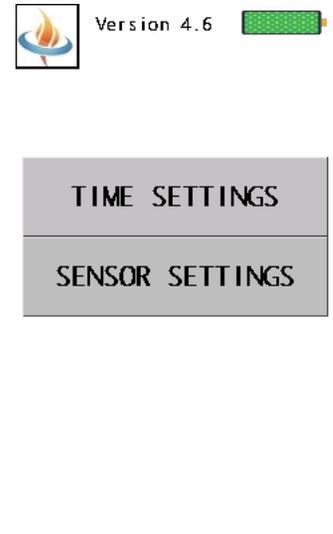
Time Settings:

Before using the launcher in a time zone, make sure that the local time has been set on the launchers. This will assure that the time stamps are accurate. The clock inside the launcher may drift so make sure to check it from time to time.
The timestamp may be displayed in MM/DD/YYYY 12H AM/PM or DD/MM/YYYY 24H format. Please choose the most convenient format for your needs.

N.B: Once the starting time has been sent to the sensor, it keeps a very accurate track of time. The time drift of the sensor should be less than 10 minutes per year.

Increase Wireless Range: if you need to be able to access the sensors from far away (if for example the respondent is not home and you cannot come closer to the stoves), you can check this box. This option will increase the radio power of the antenna and allows to detect sensor from further away.

Sensor Settings

The cooking detection algorithm is simple: by default, as soon as the stove temperature is 3C above the ambient temperature, the sensor assumes there is a cooking event and cooking events separated by less than 20 minutes are merged together.

In the Exact settings, you may change the cooking event detection threshold and the time between cooking event being merged.

Once set those values are used for every EXACT sensor.

You can restore default value by checking the box at the bottom of the screen.
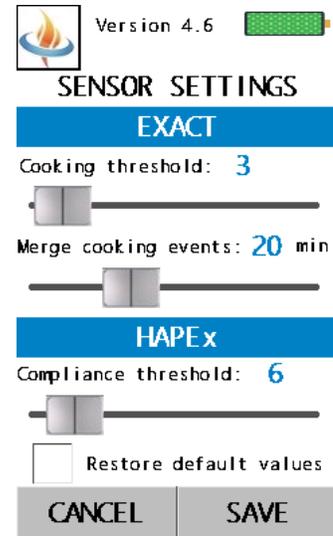
CHARGING THE LAUNCHER BATTERY.

The battery is recharged via the micro USB port. In two hours the battery will be fully charged. The battery level is displayed on the top right corner of the screen when the device is powered.

A fully charged battery should last a couple of days of intensive use.

CHANGING THE STOVE LIST

A list of 14 different stove names is stored into the launcher. This list should be customized to your specific project area. The stove names allow to easily know on which stove the sensor has been placed. It also allows afterward to run interhousehold analysis and to automatically group data by stove type. So it is important that the stove names are consistent across your study.
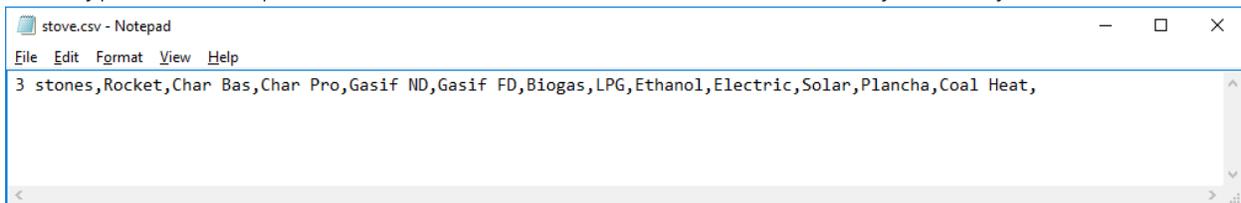
The stove names are stored in a file on the SD card called "stove.csv". You can open this file in a text editor (like notepad, it is better to not use MS Word or Excel for that) and change the name of the stove. Each name is separated by a coma, don't add any space or carriage return (no need to press "enter"). The best way of assure consistent names is to edit one file and then to paste it onto the SD cards of all the launchers used in your study.

N.B: The stove names are limited to 9 characters.

N.B: It is important that you don't change the name of the file (stove.csv) so that the launcher will know to look in this file for the list of stove names.

A NOTE ABOUT TEMPERATURE MEASUREMENT WITH IR SENSOR

IR sensor are great because they don't require any contact to measure an object temperature. This allow to monitor open fire easily for example.

There is a few things that affect the temperature measurement accuracy:

- The sensor has a 45-degree vision cone, so the further it is form an object the larger the area measured. The sensor will display the average temperature across its vision cone.
- The measurement is influenced by the object emissivity. Objects that reflect light (like polished stainless steel) tent to reflect the IR and the measurement will not be as accurate as for object that are painted.

This does not prevent the sensor from accurately detecting cooking event and cooking time.

SENSOR PLACEMENT

The EXACT Sensor can withstand an internal temperature of 85C. Because of their mounting system, that means they can be placed on surface that will be as hot as 300C.

However, the limitations associated with the fixation technique should be considered too. The epoxy putty provided with the sensor is rated for 250C so it best to place the sensor in a location that will not get hotter than 250C if the epoxy putty is used.

To mount the sensor on metallic stoves with the epoxy putty provided, please follow this procedure:

- Clean the surface of the stove with the alcohol wipe provided
- Sand the surface with the sand paper to roughen it
- Clean the surface with another wipe (wait a minute for the alcohol to dry)
- While the alcohol dries, cut a piece of epoxy putty
- Knead the putty thoroughly during one minute (use plastic gloves)
- Place the putty on the sensor mount and press it firmly against the cleaned stove area
- Cut a piece of the high temperature tape provided and place it on top of the sensor mount and epoxy to reinforce the initial bond.
- The epoxy has a 5 minutes working time and a 1-hour full cure time.
- If possible place the sensor will the stove is not too hot.

If this procedure is followed, a very strong bond will be created that can last for years. Actually, the sensor will probably be difficult to remove afterwards.