# The fireball
# OXYPROBE

## by Axner's Storm Equipment*


# A user's guide

## The fireball **Oxyprobe**

### is manufactured by Storm Equipment and distributed by...

* "Axner" and "Storm Equipment" are trade names of Laguna Clay Company

# The Fireball Oxyprobe™

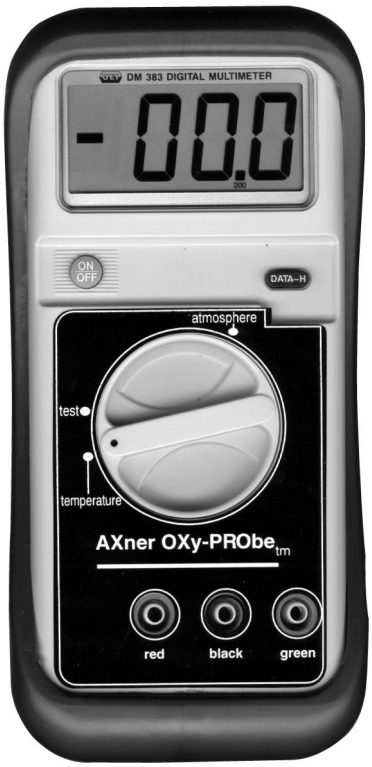
The **FIREBALL Oxprobe**$_{tm}$ is a precision instrument designed to improve the firings in fuel-fired kilns. The **FIREBALL Oxprobe**$_{tm}$ will likely pay for itself in fuel savings alone because it will indicate precise neutral combustion in the firing atmosphere which is the most efficient firing condition using the least fuel for maximum heat rise. Whether you are firing high-fire reduction, oxidation whiteware or medium fire there are periods in the firing when neither reduction nor oxidation is required—just efficient combustion and maximum heat advance is desired. It is not unusual for savings of 25% or more in fuel consumption when using the **FIREBALL Oxprobe**$_{tm}$.

More importantly the **FIREBALL Oxprobe**$_{tm}$ identifies precise combustion atmospherics no matter what the weather conditions are. For instance, when the weather is clear and the barometer indicates high pressure there is more oxygen available to the burners. If you set the available air to the same physical setting each time, i.e., a primary air flap or electronic control, you may be varying the oxygen/fuel ratio by 20% or more relative to the air available when it is stormy and the barometric pressure is low. Many potters note that they get "better reduction" in stormy weather. What actually is happening is they are simply using the same settings for their burners and getting less oxygen. When you have the **FIREBALL Oxprobe**$_{tm}$ you adjust burners to the atmospheric indication on the digital meter; a specific reading desired for your firing— you get repeatability! When you fire with the **FIREBALL Oxprobe**$_{tm}$ you will want to chart the firing. Noting time into the firing, plot the atmospheric reading and the temperature. The **FIREBALL Oxprobe**$_{tm}$ provides both. Now you have a reference chart from which to experiment. Each firing should be charted and adjustments noted. At some point your particular glazes will fire efficiently and beautifully. You have the readings charted and no matter what the weather conditions you can repeat the results.

Along the way you should note what your kiln looks like when it is firing properly. For one thing, you will not be producing black smoke and soot. It is interesting how many potters believe they have to have black smoke to indicate heavy reduction. Nothing could be further from the truth! Soot and smoke **reduce** reduction effects because free carbon interferes with the production of CO (carbon monoxide) and hydrogen—both desirable for reduction and produced when the oxygen/fuel ratio is *slightly* unbalanced in favor of fuel. As soon as there is so much excess fuel that free carbon is produced CO and hydrogen production is almost eliminated and reduction ceases. The **FIREBALL Oxprobe**$_{tm}$ can actually demonstrate this for you. Most importantly, besides not improving reduction, smoke and soot simply mean that fuel is being wasted, and probably there is little or no heat rise taking place. The **FIREBALL Oxprobe**$_{tm}$ is immediately instructive—a window of observation, and you will notice things such as the length of a tongue of flame when the **FIREBALL Oxprobe**$_{tm}$ reads medium reduction. Or what the shape of the burner flame is like at a certain pressure. Note these things and anticipate them. At some point try firing without **FIREBALL Oxprobe**$_{tm}$ readings or see if you can adjust the burners to good reduction conditions before checking the atmosphere readings on the meter. Use the instrument to learn how your kiln functions.

# The Fireball Oxyprobe™

The **FIREBALL Oxprobe**$_{tm}$ is designed to be inserted into the combustion atmosphere of fuel fired kilns operating to temperatures of approximately 2400° F or less. The sensor tip is an oxygen sensing pellet made of zirconium/yttrium plated with a thin platinum conductive layer. This is the heart of the PRObe as it produces a signal indicating the relative percentage of oxidation and/or reduction in your firing atmosphere. This signal is expressed as a voltage on the digital meter. Inside the PRObe there is an **R** type thermocouple (platinum/platinum-13%rhodium) which handles temperatures to Orton cone 12. The **FIREBALL Oxprobe**$_{tm}$ will function as a pyrometer from start-up, but atmosphere readings are not reliable until the temperature reaches 1200°F or 6.1 on the meter. This is not a problem because you are not concerned with precise combustion atmospheres below red heat— it is important that you are oxidizing, but this is done by simply firing up with dampers well open. The zirconium/yttrium oxygen sensor is situated at the extreme end of the **FIREBALL Oxprobe**$_{tm}$. It begins to work as soon as it is heated to red heat (1200°F); at this point it becomes sensitive to oxygen atoms and when there is a differential between the number of oxygen atoms sensed at the exposed end and the end sealed in the **FIREBALL Oxprobe**$_{tm}$ tube a small voltage (emf) is produced and this is expressed in millivolts on the meter. Generally, a reading between .0 and .1 indicates an oxidizing combustion condition. Higher readings such as .1 to .2 show a neutral condition. Light reduction to .4 and medium reduction from .4 to .6. Higher numbers show heavy reduction. Less than .1 indicates an oxidizing combustion which can be just as inefficient as reducing. It depends on the percentage in each case. Ten percent oxidizing or reducing is ten percent inefficient— ten percent more fuel consumed. (note that a negative symbol in front of any number should be ignored).



# The Fireball Oxyprobe™

For temperature readings the meter's selector switch is turned to "Temperature" and the readings will be in milliamps. On your Fire Chart meter readings corresponding to specific temperatures are shown on the right-hand side of the chart. For instance, if the meter reads 6.1 the left hand column shows that reading corresponds to 1200°F. Each horizontal line on the chart indicates a 60° F increase in temperature. It is easy to extrapolate temperatures; say you get a reading of 8.3, for instance, the temperature would be 1530°F.

On the chart you will notice a firing protocol suggested for a typical reduction firing. You will generally begin a firing with the damper(s) opened insuring an oxidizing atmosphere. This is done whether you are firing greenware or bisqued ware. By oxidizing, organic material is burned and released as $CO_2$. This prevents potential bloating problems. Also, early oxidation keeps the temperature rise from climbing too rapidly besides insuring the burn of organics in the clay body.

Determining where to place the **FIREBALL Oxprobe**tm depends on a number of factors. In order to get a representative sample of the atmosphere the PRObe should not be placed directly over a burner port. Here the gasses move rapidly and because the sensor is extremely sensitive, sampling more than three times a second, the readings may fluctuate rapidly and not give a good reading. Likewise, a corner placement for the sensor is not advised because the gasses might not be well mixed. The three best placements are in the center of the door, roof or back wall. Place the PRObe where it will not touch the ware and will not likely be in jeopardy of being struck when loading. The sensor should be inserted so that the tip is approximately one or two inches into the kiln space. <u>It is extremely important that the hole be drilled exactly to three quarters inch (one-half inch in older models) through the wall so the PRObe is fitted as snugly as possible.</u> As an alternative, a larger hole can be closed up with ceramic fiber or by simply using a coil of clay. This will prevent back-pressure flames from coming out onto the knuckle of the probe and will help to prevent damage. The cable should not be allowed to touch the heated kiln. It is strongly suggested that the meter be placed in as cool a spot as possible to prevent overheating the electronic components. Treat your **FIREBALL Oxprobe**tm gently and it will function for many firings.

OPERATION:

After you have located the best placement drill the three-quarter inch hole and install your PRObe. The meter should be placed where it is cool and the cable will reach. There are three plugs of different colors that terminate on the cable. Simply insert each colored plug into the appropriately marked hole at the bottom of the meter. Turn the selector switch to the DOT marked "Temperature". Push in the small, green button marked "ON-OFF". You should see 00.1 or 00.0. Now turn the rotary selector switch to the DOT marked "Atmosphere". You should see 0.00. Push the "ON-OFF" button again to turn the meter off.

You are now ready to fire! BUT— it is suggested that for the first firing you simply fire as you have before —noting time, temperature and atmosphere readings and charting them throughout the fire. This will give you a clear picture of what you <u>have been</u> doing — good or bad. If the firing is fine you have a record of a good firing. If not, you can adjust to the suggested protocol and realize improved efficiency and probably a reduced firing time.

Tempurature in degrees F. Reference Junction at 32•F Type R

METER+

# Axner Oxyprobe FIRE CHART

| Degrees | METER+ |
|---|---|
| 2340• F | 14.3 |
| 2280• F | 13.9 |
| 2220• F | 13.4 |
| 2160• F | 12.9 |
| 2100• F | 12.5 |
| 2040• F | 12.1 |
| 1980• F | 11.6 |
| 1920• F | 11.1 |
| 1860• F | 10.7 |
| 1800• F | 10.3 |
| 1740• F | 9.8 |
| 1680• F | 9.4 |
| 1620• F | 8.9 |
| 1560• F | 8.5 |
| 1500• F | 8.1 |
| 1440• F | 7.7 |
| 1380• F | 7.3 |
| 1320• F | 6.9 |
| 1260• F | 6.5 |
| 1200• F | 6.1 |
| 1140• F | 5.8 |
| 1080• F | 5.4 |
| 1020• F | 5.0 |
| 960• F | 4.6 |
| 900• F | 4.3 |
| 840• F | 3.9 |
| 780• F | 3.5 |
| 720• F | 3.2 |
| 660• F | 2.9 |
| 600• F | 2.5 |
| 540• F | 2.2 |
| 480• F | 1.9 |
| 420• F | 1.6 |
| 360• F | 1.3 |
| 300• F | 1.0 |
| 240• F | .7 |
| 180• F | .5 |
| 120• F | .3 |
| 60• F | .1 |

1850• F return to neutral for normal reduction glazes. Begin reduction again at 2000• F

1650• F begin reduction for body and/or copper reds. Show .55 on atmosphere. Hold to maturity for reds. Return to neutral at 1850• F for reduction glazes.

red heat-show .10 neutral atmosphere +

300• per hour line

NOTES:

| TIME | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | HOURS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

+ +

Note that on the FIRE CHART there is a straight line starting at zero time and zero temperature. It represents a heat rise of 300° F per hour. This is the time line for large Orton cones and the closer you come to it as a reference on the chart the closer the indicated pyrometer readings will correspond to your cones. By the way, it is suggested that you always have a cone pack in a view port and do not rely solely on a pyrometer for temperature. Also, remember that cones melt on the basis of time and temperature—pyrometers respond to temperature only.

If you are bisque firing or firing a green load once-fire to glaze maturity you will definitely not want to heat up rapidly. You may want to candle overnight and/or heat at a rate of 160°F per hour to red heat. Either way, be sure to have dampers open for an oxidizing atmosphere.

RED HEAT- 1200°F (6.1 on the meter) At this point you will want to turn your burners up to their maximum capacity and fire as rapidly as possible adjusting any desired changes in the atmosphere as you proceed. This will save fuel and time with no deleterious effects on the clay bodies or glazes. In most cases you won't be exceeding 300°F per hour and as you approach the maturing cones try for about one half hour between the warning cone and the final cone. If you want to soak, fine, but one half hour between cones should be sufficient.

DATA HOLD

Finally, the meter has the capability to hold a display if desired. At any time you can activate this function by simply pushing the small black "data hold" button on the upper right side of the meter. To release just push again.

## TROUBLE SHOOTING

TEST

You will notice that there is a place on the meter where the selector switch can be turned to "Test". If you are getting random readings on the temperature readout the thermocouple may have separated at the tip where the two legs are welded together. If you suspect this may be the case turn the selector switch to "Test"— **but first switch the red and green plugs**. If the thermocouple is broken you will see a "1" on the LCD readout panel on the extreme left side. If the thermocouple is intact you will hear a high pitched tone from the meter indicating continuity. If you think the thermocouple tip has separated you can simply return the PRObe to Axner Pottery Supply for repair at nominal cost.

If your battery begins to wear out the meter will automatically warn you with a "lo batt" showing in all functions. To change batteries, remove the protective rubber boot and unscrew the case cover over the battery compartment. Replace with a fresh nine volt alkaline type battery. After replacing the battery replace the boot for continued protection.

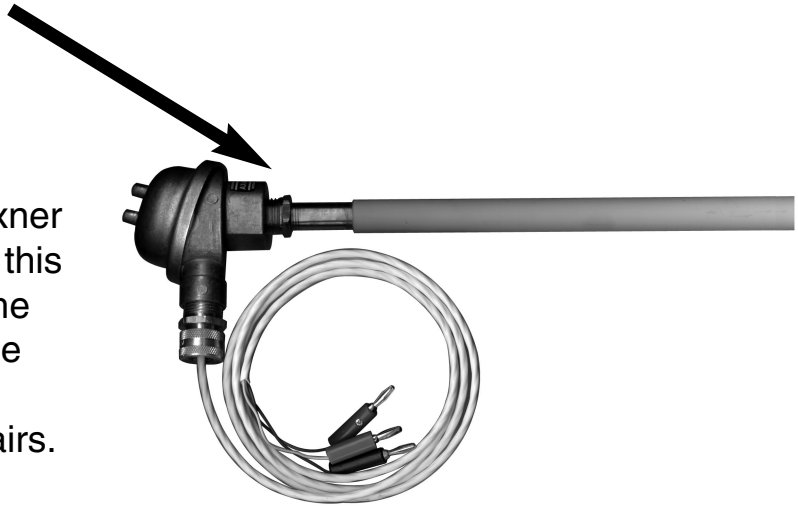
There is 40" of wire inside the **FIREBALL Oxprobe**tm —all of it platinum. One length of it is partially exposed to the combustion atmosphere where it is wrapped around the exterior portion of the oxygen sensor. Over time this wire will get brittle and need to be replaced. The **FIREBALL Oxprobe**tm is designed so the protection tube can be removed and the wire replaced. If your PRObe is not producing reliable atmosphere information it is likely that this wire has become brittle and has broken. Simply return the PRObe to Axner Pottery Supply for repair at nominal cost.

**Trouble Shooting, continued...**
If your probe is placed near or directly above your burner, you may experience significant fluctuation on your readings. This is not due to a flaw inthe probe but rather it accuately reflects how the atmosphere is rapidly changing in some areas of the kiln. It is best to place the probe in other parts of the kiln as earlier described in this manual

Temperature readings are relatively accurate, but use the chart as a guide rather than an absolute. Cones are the most accurate indication as to when your pottery reaches maturity.

# Important Notice

## This part right here



This part right here... is a tube that threads into the junction box of the Axner OxyProbe. Please do NOT unthread this tube. Unthreading it might damage the probe and may void the warranty. The part is made to unthread only at our facility for the purpose of making repairs.

# The Fireball OXYPROBE™



## Axner*

**490 Kane Court, Oviedo FL 32762**
**Phone: 800-843-7057 or 407-365-2600 • FAX: 407-365-5573**
**e mail: axner@axner.com • web site: www.axner.com**


AXNER

*Axner is a trade name of Laguna Clay Company