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Using Summer High Load Factor Testing As A Means To Plan Fall Maintenance

Cost effective maintenance and maximum capacity, reliability, efficiency and environmental performance is every coal plant managers' goal. One good and informative approach to using limited maintenance funds to maximum advantage is to conduct comprehensive boiler performance tests during the high load factor summer months, so that the root causes of slagging, fan capacity shortages, high LOI, SCR popcorn ash and other issues can be identified and quantified early, before the final outage work scope is developed. Put another way; use a comprehensive diagnostic test to develop the outage work scope.

Here is an outline of how STORM does it:

1.0 Oxygen Rise Tests: Furnace to Stack

These should be run periodically to monitor boiler air in-leakage, air heater leakage, and duct air in-leakage. These problems can sometimes be corrected on line, if not they can be added to the "outstanding maintenance list" and corrected at the first scheduled (or unscheduled) outage. The preferred excess oxygen levels are shown on Figure 1.

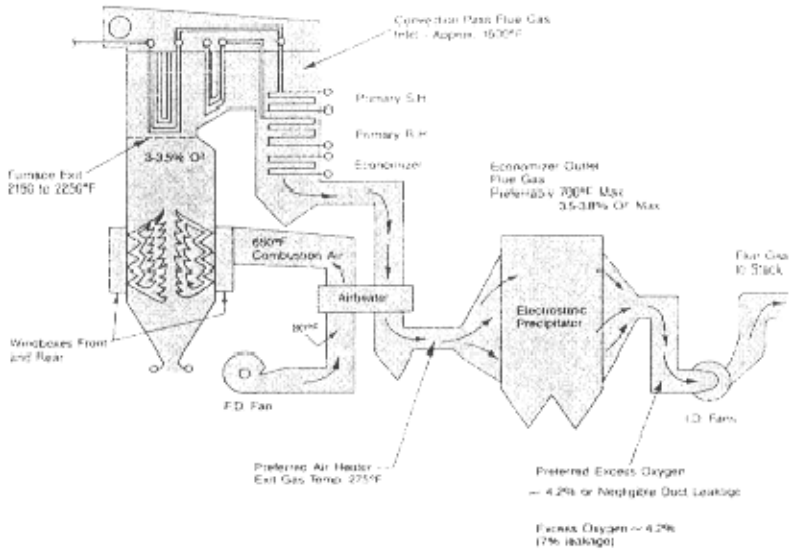


Figure 1

The furnace exit must have a slightly oxidizing environment at all points. A reducing environment (No Free Oxygen) will promote slag formation, high gas temperatures and contribute to high carbon in ash.

We think HVT's should be conducted at least quarterly. Measuring the oxygen rise from the furnace to the stack is quite useful in quantifying air in-leakage.

In our experience, this is one of the primary problems of balanced draft boilers. Excessive air in leakage is especially significant on 30+-year-old units. The costs of undiscovered and corrected air in leakage is among other's; limited production capacity due to ID fan limits, high carbon in ash, slagging, fouling, heat rate penalties, catalyst plugging due to cinder carryover from high FEGT's, and more.

Quantifying the air in-leakage during the summer high load factor operation provides an opportunity to cost-effectively correct the sources of air in leakage during the fall outage season.

2.0 Balancing Fuel Lines

Balancing fuel lines by use of a clean air test may seem old fashioned. But it works and this is the first step in fuel line balancing. STORM equipment includes Pitot tubes and clean air testing kits.

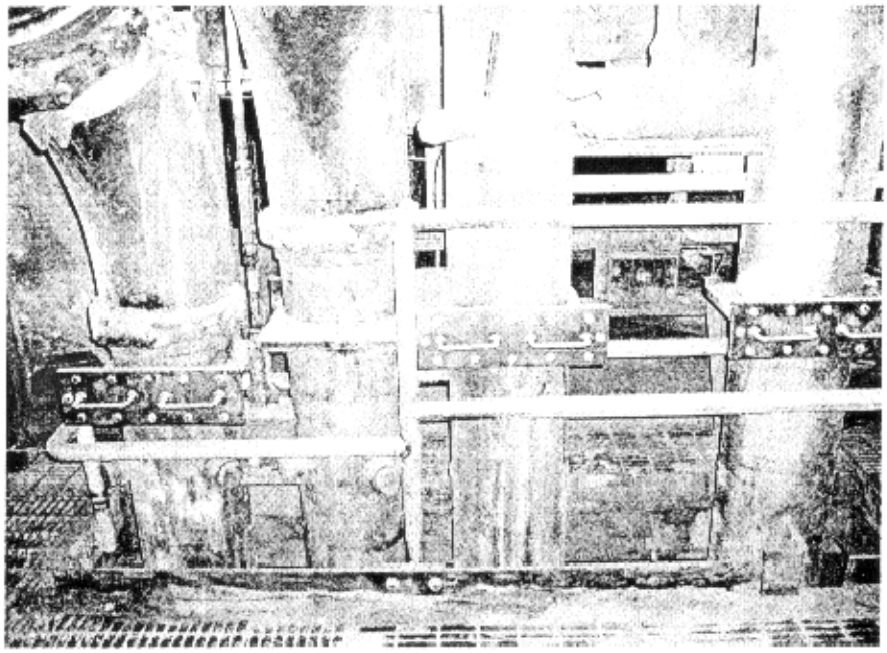


Figure 2

Figure 2 shows orifice housings installed in the fuel lines to make fixed orifice changes more expeditious. Measuring the fuel line velocities on clean air and then inserting the proper orifice sizes is the first, and important, step in fuel line balancing. Later changes to the classifiers or coal riffles may be required, but the balancing of system resistances, in our experience, is an absolute pre-requisite.

3.0 Fuel fineness and distribution

Fuel fineness and distribution is best determined by using the Storm Isokinetic coal sampling kit.

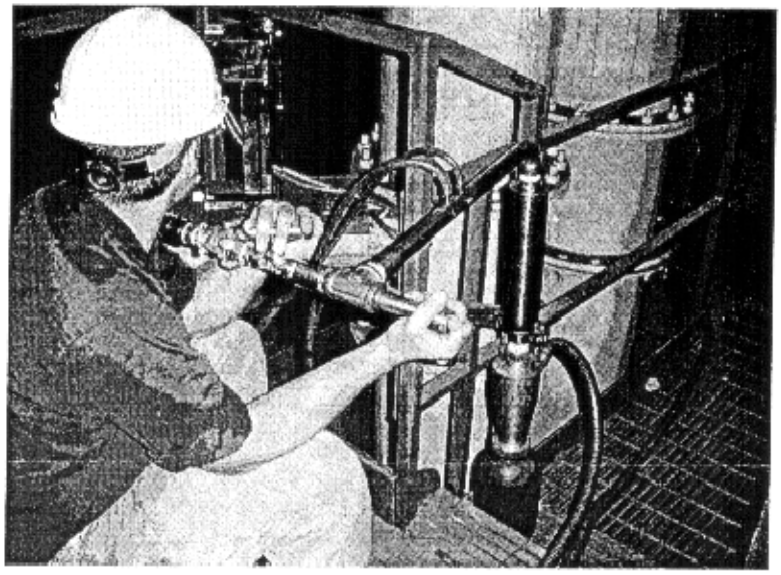


Figure 3

Fuel Fineness of at least 75% passing 200 mesh and 0.1% maximum on 50 mesh is important for achieving optimum combustion. Fuel sampling should be conducted in vertical up flow coal piping several diameters from elbows, or orifices.

Fuel fineness and distribution is absolutely essential to achieve optimum performance with the environmental restrictions in place these days. Low NOx operation affects nearly every customer that we have worked for. Fuel changes to the most economical and environmentally friendly coals are also the norm. Combine high load factor operation, with harder or lower HHV coal, and lower fusion temperature ash, and the fuel fineness and distribution better be close to optimum. If the mills need changes in the fall outages, now is the time to develop that work list and order parts. All mill performance changes and adjustments should be judged by testing all fuel lines. The Storm Technologies, Inc. Isokinetic coal sampling kit is time and Results proven.

4.0 Representative Flyash Sampling

Representative flyash sampling is a must. I said representative flyash sampling, not just flyash sampling. The most practical method to sample flyash is to utilize the STORM near Isokinetic, flue inserted flyash sampler. Sampling at least 30 points in each duct requires about 2 hours with interested and motivated test personnel. One in use is shown below.

It is suggested that permanent brackets be mounted at the test locations to store the probes. Also, permanent compressed air supply lines close to the test location. This greatly simplifies the technicians' task of performing the representative flyash sampling tests. The largest effort involved is in getting set up. So, if it is made more convenient to do the testing, then the technicians are

more enthusiastic about doing this important test periodically. Weekly tests are a good idea. Not only good reference of the flyash LOI, but flyash sizing and fine/coarse particle LOI is an early indicator of mill and airflow problems.

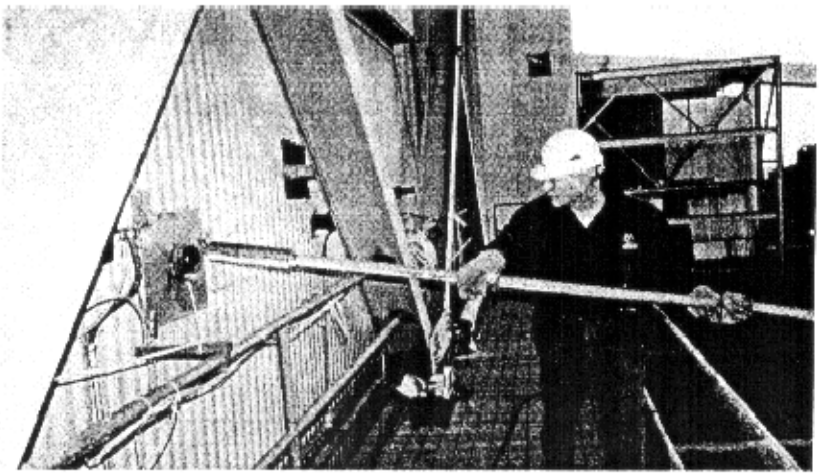


Figure 4

This is a very cost effective test device, which can reveal much about combustion effectiveness in the furnace.

Sample analyses by sieving and determining the coarse particle, fine particle and composite carbon content is useful in troubleshooting. Again, the key word is, get a representative sample of flyash first. Then do the carbon in ash analysis for fine, coarse and composite sizing and LOI.

5.0 Airflow measurement device calibrations are important!

Airflow management, that is measurement and control of the primary airflow, secondary airflow, and overfire airflows, is important. Pulverizer optimization has much to do with the accuracy of the primary airflow measurement and control. Furnace residence time is finite. Therefore, accurate proportioning of the combustion airflows is important. STORM prefers the use of venturis for primary, secondary, and overfire airflow measurement. The "secret" to accurate airflow measurement on boilers, where the ductwork is not arranged like an aircraft-testing wind tunnel, is to perform hot calibration traverses. Storm prefers the use of our own design venturis and calibration by STORM designed forward-reverse Pitot tubes.

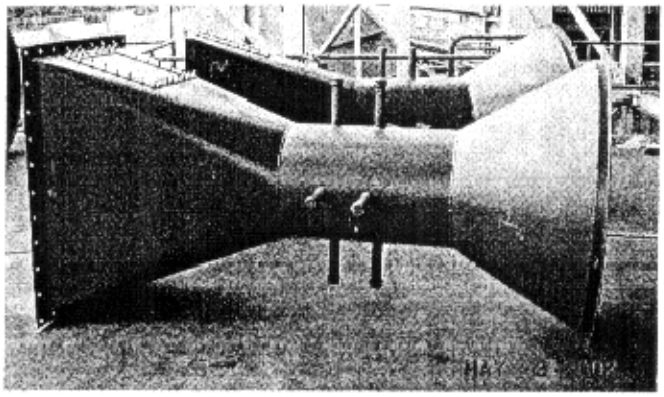


Figure 5

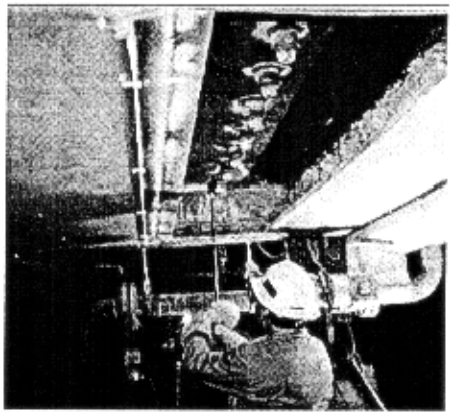


Figure 6

The key to successful airflow measurement accuracy, based on our experience is, good design application and accurate (Hot-K) field calibrations.

Storm Technologies, Inc. takes great pride in being results, oriented. Doing so, in our experience, is best done by taking a comprehensive approach to boiler performance optimization, from the raw coal supply to the stack.

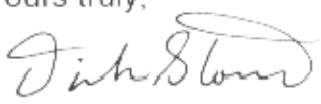
Combustion optimization is done for at least eleven reasons. These are:

1. Furnace NOx production
2. Upper furnace slagging
3. Lower furnace slagging
4. Flyash unburned carbon content
5. Stack carbon monoxide levels
6. Fire lower cost, lower quality fuels
7. Improve boiler efficiency and unit heat rate
8. Increase unit capacity
9. Maintain or improve high reliability
10. Improve electrostatic precipitator performance, which is adversely impacted by high carbon in ash.
11. Reduce SCR catalyst plugging

Applying the 13 Essentials is a great start in minimizing forced outages, capacity limitations or environmental stress on management.

Our products and services have evolved over the years based on getting results, and by providing the best field services that we are capable of performing. If you would like a copy of our catalog of products and services let us know or visit our web page at www.stormeng.com

Yours truly,



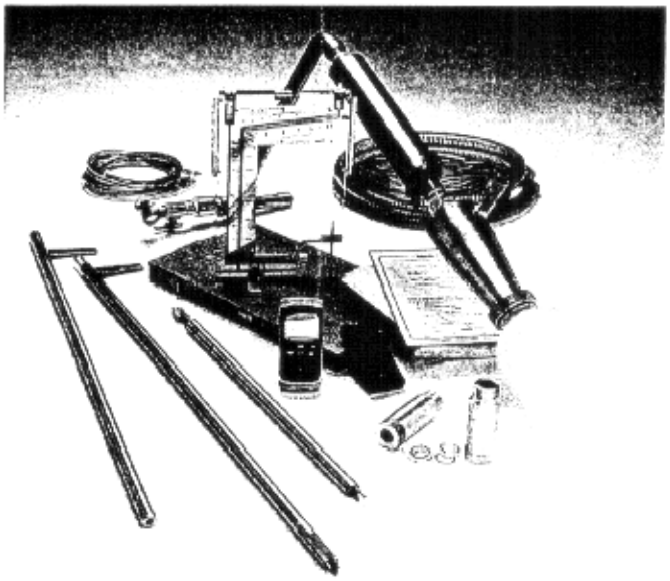
Richard F. Storm

Reminder:

Large Electric Utility Boiler Combustion and Performance Seminar

Storm Technologies, Inc.'s summer seminar will be held August 3-4, 2004 at the Hyatt at Southpark in Charlotte, NC. With an informal setting, the seminar is a great opportunity to discuss general and specific boiler issues with Mr. Richard Storm and other colleagues and professionals. Updated every year, this seminar addresses current concerns, while emphasizing the basics, such as the 13 Essentials. For NC professional engineers, this seminar is a great way to get in those Professional Development hours.

For more information, or to register please contact our office at: (704) 983-2040 or storm@stormeng.com, or visit our website at www.stormeng.com.



Isokinetic Coal Sampling Kit

Includes:

Stainless steel coal sampler w/filter canister, cyclone separator, Orifice Aspirator Assembly, H.D.P. Sample Container with O ring, Extra Filter Paper, 10ft section of reinforced tubing w/clamps, 1) coal sampling probe, 1) calibrated dirty air probe, 1) temperature and static probe w/ type "K" thermocouple, 2) dustless connectors, digital manometer, 10" vertical incline manometer w/18" pitot tube and steel carrying case, 1 lot of required heavy wall 3/16" tubing, 1) 8ft type "K" thermocouple lead wire with connections, labels and spare seals.

Unit Price: **$6,500.00**

Storm Dirty Air Test Kit:

Includes:

(1) Calibrated Dirty Air Probe, (1) 10" Vertical Inclined Manometer with case and 18" Standard Pitot tube, (1) Dustless Connector, (4) Dustless Connector Seals, (1) Digital Manometer, (1) Digital Thermometer, lead wire and (1) lot of heavy wall tubing.

Unit Price: **$2,350.00**

Only Dirty Air Probe Pictured

Storm In-Situ Flyash Sampling Kit

Includes:

Sample canister, nozzle tip, perforated cylinder, 50 filters, aspirator assembly, optional pipe length, required air connection fitting and procedures.

Unit Price: **$1,850.00**

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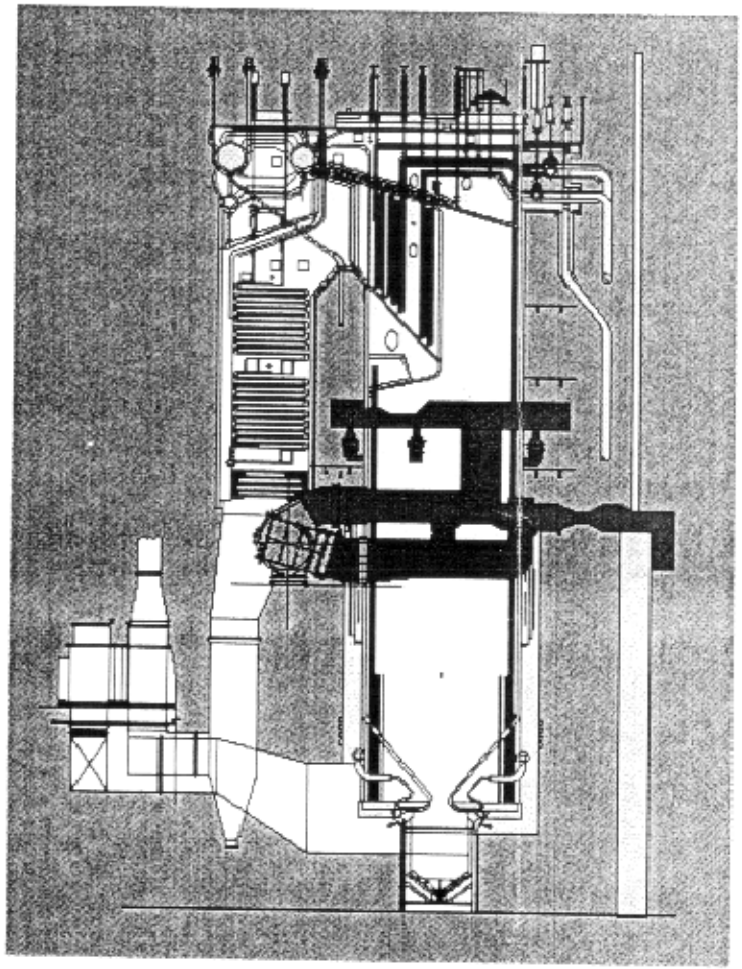
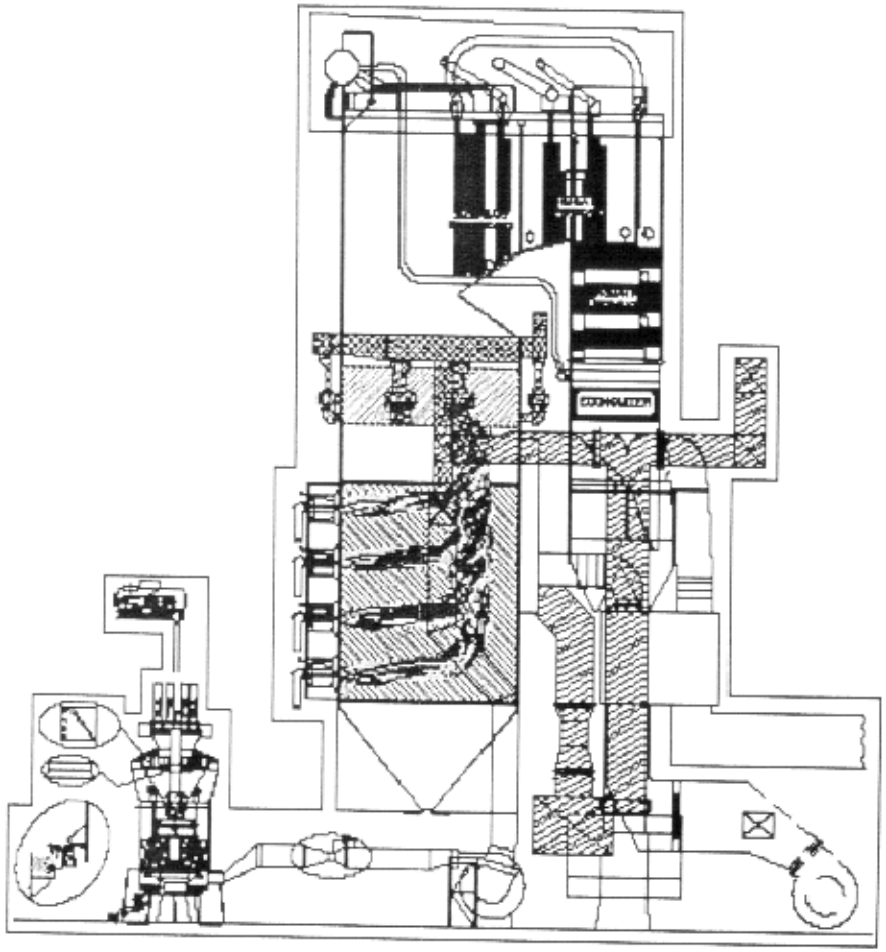
The STORM Total Combustion Optimization Approach

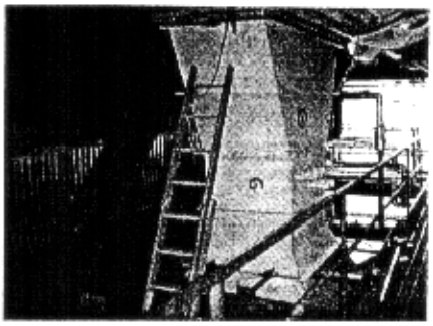
Pictured below are two examples of STORM's total combustion systems. In our experience, addressing issues such as: NOx, slagging, flyash carbon content, waterwall wastage, heat rate, SCR flue gas stratifications, SCR cinder plugging, SCR ammonia slip and SCR catalyst life are best confronted with a total system approach. By applying the 13 Essentials in terms of the entire system, you greatly increase the plant's capacity, reliability, efficiency and environmental performance. STORM Total Combustion System Optimization included in the STORM Total Combustion System is fan boosted overfire air. The key to success has been the comprehensive or "holistic" approach of addressing the combustion system, beginning at the yard coal crusher, and all pulverizers, airflows, and burner components from the coal silos and F.D. fans to the stack. This approach has been tried and proven, where Storm Technologies, Inc. has a true "partnership" with well-run power plants. Excellence in O&M and incorporation of STORM equipment and combustion optimization concepts is what achieves RESULTS.





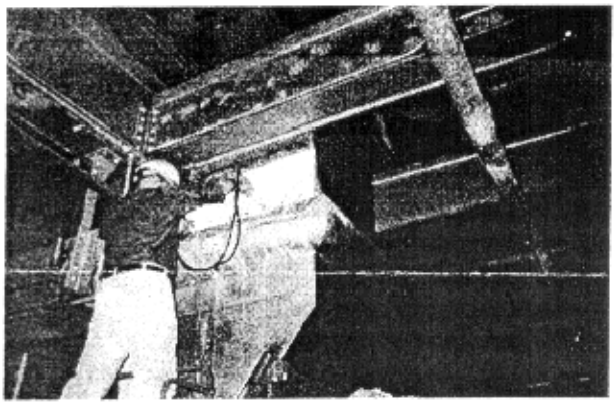
Storm Airflow Measuring Devices

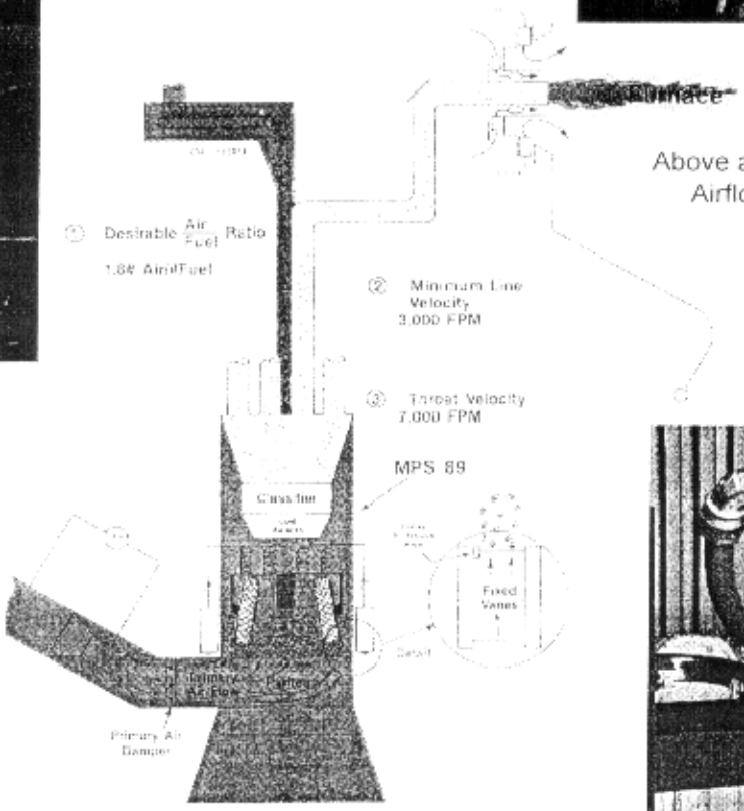
The Storm approach to flow measurement is to apply proven and unique applications of venturis and flow nozzles



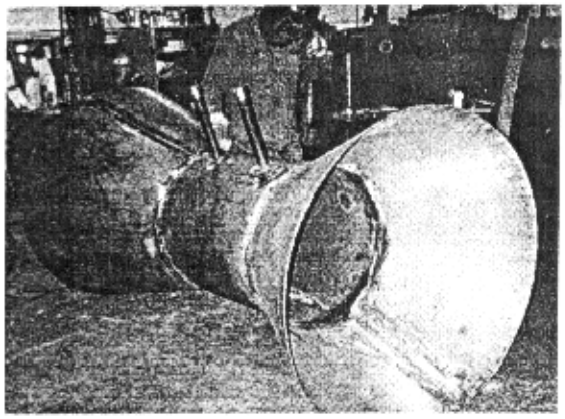
The proper STI technique of the hand traverse, hot "K" calibration is the "secret" to accurate airflow measurement and control.

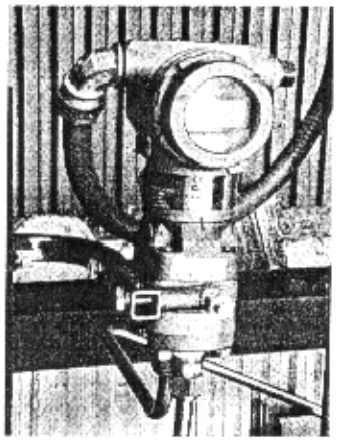
The Storm approach to pulverizer primary airflow measurement and control.





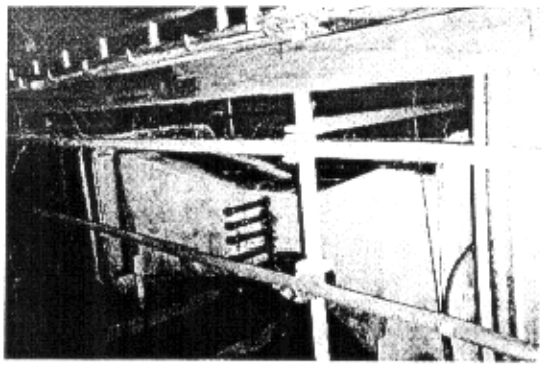
Above a venturi for Overfire Airflow Measurement





Above typical pressure transmitter installation for airflow or flue gas flow measurement

Storm has designed both round cross sectional area, as well as rectangular flow nozzles and venturis for primary airflow, secondary airflow and overfire airflow measurement



To the left, Storm designed primary air venturi. Key to the success in difficult applications is the "Hot K" calibration.