



THE FORENSIC ENGINEERING REPORT

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BOILERS AND FURNACES OF YESTERDAY AND TODAY

Over the years, everything that surrounds us has gotten smaller, from televisions and computers to automobiles. Boilers and furnaces are no exception. In recent years, in order to be more competitive with the gas industry, oil burner manufacturers have continued to try to reduce the size of their products. Back in the 1940's, when heating systems began to convert from coal to fuel oil, the heating systems tended to be rather large. This was mainly because heating systems prior to the '40's required a dry base section where the coal grates were located and coal burning took place. The heat produced then passes through the upper flue area of the boiler to create steam or hot water, depending on the system design.

As far back as the 1950's, a slow transition had begun. Boilers were no longer requiring the dry base area beneath the cast iron sections because coal fired units were being phased out. Oil-fired boilers began to incorporate a more modern "wet base" design. The early dry base, coal-fired boiler units had cast iron sections on top of a dry base which was insulated to keep the products of combustion from transmitting through the dry base walls. Boiler manufacturers then incorporated boiler design known in the industry as wet base boilers.

Advantages of Wet Base Boilers

Two important factors were accomplished

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THE HAZARD OF PUFF BACKS IN OIL BURNERS

A puff back is a misfire in the furnace that can send soot throughout a building, requiring expensive cleaning and restoration, along with repairs on the heating system. If the soot problem is detected early, the repair costs tend to be lower than if the problem is put off causing a more serious puff back.

In recent years puff backs have been decreasing, however, they still tend to be an issue if steps are not taken to properly maintain the heating system.

After performing thousands of field investigations, we have found that occasionally a file comes to us for investigation in which the insured faces a loss on a puff back. Sometimes we find that the cause of the alleged puff back is nothing more than an obstructed chimney. Other times, the answer is not quite as simple.

The service records pertaining to the heating unit often reveal clues. If the loss is related to any type of servicing error omission, the use of the service invoices can be instrumental in developing potential action against the parties liable, possibly for the faulty servicing. Modern heating equipment, especially equipment used in the oil industry, has now incorporated a cadmium cell sensor, a safety device to 'see' the flame. This helps prevent puff backs.





BOILERS AND FURNACES OF YESTERDAY AND TODAY CONT'D

by switching to a wet base designed boiler. The combustion chamber was now surrounded on five sides with boiler water: the crown area over the combustion chamber; the two side walls; the rear wall; and the floor of the combustion chamber area. All of these areas surrounding the combustion chamber contained water and were utilized in making the boiler more efficient in transferring the combustion chamber heat to the surrounding water jacket.

Earlier dry base boilers did not have combustion chambers encompassed by water. The sides of the dry base boiler contain insulation and only the crown area was exposed to the products of combustion to allow heat transfer. By switching to the wet base design, the boiler manufacturers no longer needed a dry base and boiler size was reduced by approximately 30%.

Also during this transition to more compact boiler, the oil boiler manufacturers tightened the flue areas through which the combustion gases passed on their way to the breach to exit through the homeowner's chimney. In early boilers, which were designed for coal fired systems, the flue areas in the upper portions of the boilers had to be large open areas because of the dust, soot and products associated with coal burning, as well as the early fuel oil, which was not very well refined.

Over the years, with the advent of the new flame retention type burners and more refined oil distillates, the boiler manufacturers were able to downsize the boilers and reduce the flue passages in the upper area of the boiler to allow just enough room for the hot gasses to pass through. This new design, in conjunction with the wet based design of the modern boilers, resulted in the higher efficiencies we now see.

Additionally, the oil boiler manufacturers now can compete with makers of smaller gas boilers which still utilize a dry base design. On gas-fired units the burner area is not surrounded by water, in like wet based, oil-fired boilers, because combustion air is required to fire the gas burner jets.

The Trend Toward Thinner Castings

Because of this craze to downsize the boiler and increase efficiencies with both the oil-fired and gas-fired units, the manufacturers also have thinned out the castings from which the cast iron boilers are constructed. Years ago, with the higher temperatures associated with coal burning equipment, the cast iron from which the boiler was constructed was a very thick solid cast iron material.

Today manufacturers realize that the thinner the cast iron material, the more efficient the heat transfer will be from combustion through the cast iron into the water of the heating system. They have also thinned out the castings to make boilers more compact.

While the use of fuel oil is still common in the northeast U.S., in today's world, natural gas is the fuel of choice for the majority of American homes. For those used to country living, propane is the fuel of choice when natural gas is not available. Natural gas/propane furnaces sold today are very efficient and there is a tendency to think these gas furnaces are so clean and reliable they need no maintenance. Nothing could be further from the truth. Forced draft fans, heat exchanger surfaces, gas burners, shut-off valves, etc., all need periodic inspection and maintenance. For example, inefficient combustion due to poor flame stability can be traced to gas burner malfunction and/or deterioration. Heat exchanger surfaces can become brittle and crack. Service inspections can miss these problems.

By: Peter Vallas and Steve Feeney, PE, CFEI

THE HAZARD OF PUFF BACKS CONTINUED

The cleaner burning heating units on the market today do not build up soot in the boiler flue passage areas. The new heating equipment, if kept properly serviced, burns almost soot free. In a modern heating system, even if a delayed ignition occurred, it would merely cause the inconvenience of a blown down chimney smoke pipe or a burner door being blown off, with very little soot emanating from the heating unit.

On the other hand, a fuel burning heating system more than 20 years old and not properly maintained tends to cause excessive debris in the form of soot in the boiler. Once the soot debris in the boiler occurs, two things can happen. Either the chimney becomes obstructed to the point where all combustion products enter the structure or a build up of carbon around the igniters causes a delayed ignition. This subsequently causes the soot, which is built up from improper servicing of the unit, to be scattered about the edifice.

Also, when an investigation on a heating system is required, the insured should supply all servicing records of the heating system to the local I-ENG-A member firm in order that their onsite inspection can identify items replaced or not replaced before a loss.

Article by: Peter Vallas, Sr., I-ENG-A Advisor



OIL BURNER RUN-OUTS AND FREEZE-UPS

Today modern heating equipment that is properly serviced and maintained gives the customer very reliable and dependable heat throughout the winter months. Usually, when there is a problem with the heating system, it can be traced to improper servicing by the heating technician or neglect by the owner.

In many areas of the country, a heating system that fails would generally give the owner approximately 24 hours to re-establish heat within the structure before any major freeze-up condition occurs. This is a loose rule of thumb used in the industry, and naturally could vary greatly, depending upon the construction of the premises and the outside temperature during that period. Below zero temperatures are infrequent in many areas of the country and usually rebound the following day.

Almost all fuel oil companies use a computer to calculate the fuel usage of its customers. The system which is standard throughout the oil industry is called a degree-based system. This system establishes a temperature at which most heating systems would be turned on. Each hour that the temperature remains below this established degree of Fahrenheit, "degree days" or numbers add up. Depending on the total numbers, each customer is given a factor, which is called a "K" factor, and is utilized in calculating that particular customer's fuel usage.

One of the pitfalls in this type of operation is that if one month the customer goes away and turns the thermostat down to 55°, the "K" factor will reflect this usage. Unless the fuel company is notified, the computer will be told that the customer's usage has fallen off. Now, if the customer returns and raises the thermostat to 72°, the computer will calculate the fuel usage on the lower thermostat setting until the next fuel delivery is made. This has caused problems with the degree based system and is one reason that oil run-outs occur.

The other reason for a failure of a heating system would be as stated earlier, improper servicing and/or lack of proper, annual maintenance by the owner of the equipment.

Another important factor to keep in mind with freeze-ups is that if any homeowner leaves his house for an extended period of time during the winter months, a check on the property should be made at least every 24 hours.

It is very important that, prior to leaving, the homeowner turn off the main water valve in the basement. One of the reasons large losses occur is that the homeowner leaves the water service to the house on. Once the freeze-up occurs, the pipes throughout the structure rupture. Large-

loss damages result when the temperature goes above freezing and water cascades throughout the structure unchecked until someone notices water coming out the basement windows or front door. If the homeowner had taken the simple precaution of shutting off the water service in the basement, a small freeze-up loss would not have turned into a large water damage loss.

There are many devices on the market today which incorporate automatic dialers that could be set to either 40°, 50° or 60° degrees and automatically dial a preselected number in the event the temperature within the structure falls below the set limit.

Additionally, if the heating system does fail, it is important that all servicing records be obtained in order to properly evaluate and eliminate any potential blame to the servicing company. Sometimes we find that a heating system is serviced three or four days in a row and then fails on the fourth or fifth day.

In these cases, the failure can sometimes be traced to an error made by the servicing technician in diagnosing or maintaining the system.

We hope these articles on the heating system have been helpful to you. If any additional questions arise, or if you would like help with the heating losses that will invariably occur in the next few months, please do not hesitate to contact your local I-ENG-A member.

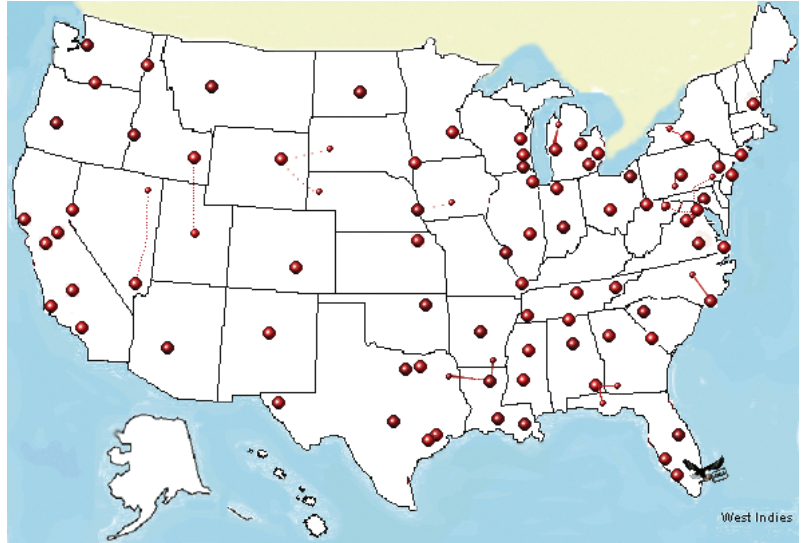
COMEDY RELIEF CORNER



COMPLIMENTS OF YOUR
LOCAL MEMBER FIRM

I-ENG-A MEMBER FIRM LOCATIONS

Did you know that The Investigative Engineers Association (I-ENG-A) is the largest forensic engineering force in the United States! We have locations with teams of professional engineers and experts as indicated by the below map.



The commentary contained in The Forensic Engineering Report is not intended, nor should it be relied upon, to replace specific professional advice. We recommend that readers consult their professional advisors regarding issues raised in this publication.

INVESTIGATIVE ENGINEERS ASSOCIATION (I-ENG-A)

Phone: 800-523-3680

Fax: 954-537-4942

E-mail: info@ienga.net

Websites: www.ienga.net | www.ienga.com

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