ABMA WARNS OF THERMAL SHOCK DAMAGE TO HOT WATER BOILERS AS A RESULT OF ENERGY CONSERVATION MEASURES

The members of the American Boiler Manufacturer's Association enthusiastically support efforts to conserve energy. The Assocation does, however, have the responsibility to advise boiler owners and operators of possible dangers caused by operation of boilers and their related systems in accordance with procedures such as those mandated by the U. S. Department of Energy or as recommended by some energy management programs which propose to shut down the boilers under certain conditions to save the fuel necessary to keep a "standby" boiler hot. Damage to the boilers as a result of such programs is beyond the control of the boiler manufacturer.

Improper operation of boilers in hot water service can result in thermally induced overstress and may cause damage to the boiler structures. The thermal shock condition results when boiler firing rates change rapidly and large temperature differentials exist between heat transfer surfaces. The thermally induced overstress is caused by the inability to the internal boiler structures to adjust to the immediate temperature conditions and can lead to mechanical damage. Although damage may not occur immediately, repeated exposure to a thermally induced overstress condition may result in long term mechanical damage due to material fatigue. The thermal shock condition may cause broken welds, cracked tube sheets, leaking tubes or other damage.

Hot water boilers must be protected from:

A. Return water of too low a temperature.

B. Cool return water in too great a flow.

C. Moving to high fire with boiler water at too low a temperature. Therefore, the temperature of the water flowing through the boiler is at lower than the normal operating temperature range. Do not increase the burning firing rate toward high fire rate more rapidly than the boiler manufacturer recommends.

D. High burner cycling rates coupled with high firing rates.

Although the Department of Energy's Emergency Building Temperature Restrictions have been cancelled, the introduction of computerized energy management and load control systems have resulted in a continuing concern for the potential of thermal shock damage. The programming of the EM/LC system may provide conditions which lead to boiler thermal overstress by imposing long off periods when a facility is not in use. Thermally induced overstress of the boiler may occur when the facility is restarted and the load demand must be satisfied in a short period of time. Even though existing boiler systems and procedures may have been developed before the introduction of EM/LC systems, a properly designed, programmed and installed EM/LC system will provide energy management benefits without resulting in boiler overstress conditions. When applying energy conservation measures, the boiler owner/operator must ensure the system utilized does not impose overstress conditions upon the basic boiler equipment.

Coordination of the boiler and the burner firing rate with water flow and temperature rise through the boiler, together with piping and control arrangements to avoid excessive thermally induced stresses and high burner cycling rates are important factors in the design of hot water heating plants. Conservation measures may suggest changes in established load and/or operating procedures. Before these changes are implemented the proposal should be reviewed by a competent engineer familiar with this specialized field, to assess their impact on the boilers.

Boilers are manufactured to very high standards of design and construction in accordance with the requirements of the ASME Boiler Code. However, boilers constructed to these high standards of quality can be severely damaged by improper operation of the system.

Properly designed systems must include protective controls and components to prevent these occurrences; proper operating procedures must incorporate protective measures. HOWEVER, SOME NEWLY DESIGNED ENERGY MANAGEMENT SYSTEMS MAY HAVE IGNORED THE BOILER'S NEED FOR PROTECTION AGAINST OVERSTRESSING.

Energy management systems which completely shuts down a hot water heating system for an extended period of time may seriously damage a hot water boiler when the system is next turned on and the cold water from the system is suddenly pumped through a hot boiler. Each new startup is a potentially damaging operation unless carefully and properly performed.

It is recommended that, prior to the installation of any energy management system on any hot water system, the supplier of such control(s) be advised of the potential to damage the boiler and to take steps within the installation of his system to ensure that the potential to damage the boiler is eliminated or minimized as much as possible.

As a guide to operating/maintenance personnel we recommended the following warning be placed on or near the hot water generation unit.

WARNING WARNING WARNING WARNING

"RAPID REPLACEMENT OF YOUR BOILER'S HOT WATER WITH RETURN WATER AT A TEMPERATURE BELOW THE BOILER MANUFACTURER'S RECOMMENDATIONS CAN CAUSE SERIOUS DAMAGE TO YOUR BOILER. DO NOT ALLOW THIS TO HAPPEN. DO NOT FIRE YOUR BURNER UNTIL AFTER WATER FLOW HAS BEEN ESTABLISHED IN ALL ZONES AND THROUGH BOILER.

WARNING WARNING WARNING WARNING

For further information consult your boiler supplier.