

## OPTION CHECKLIST NO. 8: BOILERS & THERMIC FLUID HEATERS

### Periodic tasks and checks outside of the boiler

<ul style="list-style-type: none"><li>• All access doors and plate work should be maintained air tight with effective gaskets.</li></ul>
<ul style="list-style-type: none"><li>• Flue systems should have all joints sealed effectively and be insulated where appropriate.</li></ul>
<ul style="list-style-type: none"><li>• Boiler shells and sections should be effectively insulated. Is existing insulation adequate? If insulation was applied to boilers, pipes and hot water cylinders several years ago, it is almost certainly too thin even if it appears in good condition. Remember, it was installed when fuel costs were much lower. Increased thickness may well be justified.</li></ul>
<ul style="list-style-type: none"><li>• At the end of the heating season, boilers should be sealed thoroughly, internal surfaces either ventilated naturally during the summer or very thoroughly sealed with tray of desiccant inserted. (Only applicable to boilers that will stand idle between heating seasons).</li></ul>

### Boilers: extra items for steam raising and hot water boilers

<ul style="list-style-type: none"><li>• Check regularly for build-up of scale or sludge in the boiler vessel or check TDS of boiler water each shift, but not less than once per day. Impurities in boiler water are concentrated in the boiler and the concentration has limits that depend on type of boiler and load. Boiler blow down should be minimized, but consistent with maintaining correct water density. Recover heat from blow down water.</li></ul>
<ul style="list-style-type: none"><li>• With steam boilers, is water treatment adequate to prevent foaming or priming and consequent excessive carry over of water and chemicals into the steam system?</li></ul>
<ul style="list-style-type: none"><li>• For steam boilers: are automatic water level controllers operational? The presence of inter-connecting pipes can be extremely dangerous.</li></ul>
<ul style="list-style-type: none"><li>• Have checks been made regularly on air leakages round boiler inspection doors, or between boiler and chimney? The former can reduce efficiency; the latter can reduce draught availability and may encourage condensation, corrosion and smutting.</li></ul>
<ul style="list-style-type: none"><li>• Combustion conditions should be checked using flue gas analyzers at least twice per season and the fuel/air ratio should be adjusted if required.</li></ul>
<ul style="list-style-type: none"><li>• Both detection and actual controls should be labeled effectively and checked regularly.</li></ul>
<ul style="list-style-type: none"><li>• Safety lockout features should have manual re-set and alarm features.</li></ul>
<ul style="list-style-type: none"><li>• Test points should be available, or permanent indicators should be fitted to oil burners to give operating pressure/temperature conditions.</li></ul>
<ul style="list-style-type: none"><li>• With oil-fired or gas-fired boilers, if cables of fusible link systems for shutdown due to fire or overheating run across any passageway accessible to personnel, they should be fitted above head level.</li></ul>
<ul style="list-style-type: none"><li>• The emergency shut down facility is to be situated at the exit door of the boiler house.</li></ul>

<ul style="list-style-type: none"> <li>• In order to reduce corrosion, steps should be taken to minimize the periods when water return temperatures fall below dew point, particularly on oil and coal fired boilers.</li> </ul>
<ul style="list-style-type: none"> <li>• Very large fuel users may have their own weighbridge and so can operate a direct check on deliveries. If no weighbridge exists, occasionally ask your supplier to run via a public weighbridge (or a friendly neighbour with a weighbridge) just as a check? With liquid fuel deliveries check the vehicle's dipsticks?</li> </ul>
<ul style="list-style-type: none"> <li>• With boiler plant, ensure that the fuel used is correct for the job. With solid fuel, correct grading or size is important, and ash and moisture content should be as the plant designer originally intended. With oil fuel, ensure that viscosity is correct at the burner, and check the fuel oil temperature.</li> </ul>
<ul style="list-style-type: none"> <li>• The monitoring of fuel usage should be as accurate as possible. Fuel stock measurements must be realistic.</li> </ul>
<ul style="list-style-type: none"> <li>• With oil burners, examine parts and repairs. Burner nozzles should be changed regularly and cleaned carefully to prevent damage to burner tip.</li> </ul>
<ul style="list-style-type: none"> <li>• Maintenance and repair procedures should be reviewed especially for burner equipment, controls and monitoring equipment.</li> </ul>
<ul style="list-style-type: none"> <li>• Regular cleaning of heat transfer surfaces maintains efficiency at the highest possible level.</li> </ul>
<ul style="list-style-type: none"> <li>• Ensure that the boiler operators are conversant with the operational procedures, especially any new control equipment.</li> </ul>
<ul style="list-style-type: none"> <li>• Have you investigated the possibility of heat recovery from boiler exit gases? Modern heat exchangers/recuperators are available for most types and sizes of boiler.</li> </ul>
<ul style="list-style-type: none"> <li>• Do you check feed and header tanks for leaking make up valves, correct insulation or loss of water to drain?</li> </ul>
<ul style="list-style-type: none"> <li>• The boiler plant may have originally been provided with insulation by the manufacturer. Is this still adequate with today's fuel costs? Check on optimum thickness.</li> </ul>
<ul style="list-style-type: none"> <li>• If the amount of steam produced is quite large, invest in a steam meter.</li> </ul>
<ul style="list-style-type: none"> <li>• Measure the output of steam and input of fuel. The ratio of steam to fuel is the main measure of efficiency at the boiler.</li> </ul>
<ul style="list-style-type: none"> <li>• Use the monitoring system provided: this will expose any signs of deterioration.</li> </ul>
<ul style="list-style-type: none"> <li>• Feed water should be checked regularly for both quantity and purity.</li> </ul>
<ul style="list-style-type: none"> <li>• Steam meters should be checked occasionally as they deteriorate with time due to erosion of the metering orifice or pilot head. It should be noted that steam meters only give correct readings at the calibrated steam pressure. Recalibration may be required.</li> </ul>
<ul style="list-style-type: none"> <li>• Check all pipe work, connectors and steam traps for leaks, even in inaccessible spaces.</li> </ul>
<ul style="list-style-type: none"> <li>• Pipes not in use should be isolated and redundant pipes disconnected.</li> </ul>
<ul style="list-style-type: none"> <li>• Is someone designated to operate and generally look after the installation? This work should be included in their job specification.</li> </ul>

<ul style="list-style-type: none"> <li>• Are basic records available to that person in the form of drawings, operational instructions and maintenance details?</li> </ul>
<ul style="list-style-type: none"> <li>• Is a log book kept to record details of maintenance carried out, actual combustion flue gas readings taken, fuel consumption at weekly or monthly intervals, and complaints made?</li> </ul>
<ul style="list-style-type: none"> <li>• Ensure that steam pressure is no higher than need be for the job. When night load is materially less than day load, consider a pressure switch to allow pressure to vary over a much wider band during night to reduce frequency of burner cut-out, or limit the maximum firing rate of the burner.</li> </ul>
<ul style="list-style-type: none"> <li>• Examine the need for maintaining boilers in standby conditions—this is often an unjustified loss of heat. Standing boilers should be isolated on the fluid and gas sides.</li> </ul>
<ul style="list-style-type: none"> <li>• Keep a proper log of boiler house activity so that performance can be measured against targets. When checking combustion, etc. with portable instruments, ensure that this is done regularly and that load conditions are reported in the log: percentage of CO<sub>2</sub> at full flame/half load, etc.</li> </ul>
<ul style="list-style-type: none"> <li>• Have the plant checked to ensure that severe load fluctuations are not caused by incorrect operation of auxiliaries in the boiler house, for example, ON/OFF feed control, defective modulating feed systems or incorrect header design.</li> </ul>
<ul style="list-style-type: none"> <li>• Have hot water heating systems been dosed with an anti-corrosion additive and is this checked annually to see that concentration is still adequate? Make sure that this additive is NOT put into the domestic hot water heater tank, it will contaminate water going to taps at sinks and basins.</li> </ul>
<ul style="list-style-type: none"> <li>• Recover all condensate where practical and substantial savings are possible.</li> </ul>

#### Boiler rooms and plant rooms

<ul style="list-style-type: none"> <li>• Ventilation openings should be kept free and clear at all times and the opening area should be checked to ensure this is adequate.</li> </ul>
<ul style="list-style-type: none"> <li>• Plant rooms should not be used for storage, airing or drying purposes.</li> </ul>
<ul style="list-style-type: none"> <li>• Is maintenance of pumps and automatic valves in accordance with the manufacturers' instructions?</li> </ul>
<ul style="list-style-type: none"> <li>• Are run and standby pump units changed over approximately once per month?</li> </ul>
<ul style="list-style-type: none"> <li>• Are pump isolating valves provided?</li> </ul>
<ul style="list-style-type: none"> <li>• Are pressure/heat test points and/or indicators provided on each side of the pump?</li> </ul>
<ul style="list-style-type: none"> <li>• Are pump casings provided with air release facilities?</li> </ul>
<ul style="list-style-type: none"> <li>• Are moving parts (e.g. couplings) guarded?</li> </ul>
<ul style="list-style-type: none"> <li>• Ensure that accuracy of the instruments is checked regularly.</li> </ul>
<ul style="list-style-type: none"> <li>• Visually inspect all pipe work and valves for any leaks.</li> </ul>
<ul style="list-style-type: none"> <li>• Check that all safety devices operate efficiently.</li> </ul>
<ul style="list-style-type: none"> <li>• Check all electrical contacts to see that they are clean and secure.</li> </ul>
<ul style="list-style-type: none"> <li>• Ensure that all instrument covers and safety shields are in place.</li> </ul>

<ul style="list-style-type: none"> <li>• Inspect all sensors, make sure they are clean, unobstructed and not exposed to unrepresentative conditions, for example temperature sensors must not be exposed to direct sunlight nor be placed near hot pipes or a process plant.</li> </ul>
<ul style="list-style-type: none"> <li>• Ensure that only authorized personnel have access to control equipment.</li> </ul>
<ul style="list-style-type: none"> <li>• Each section of the plant should operate when essential, and should preferably be controlled automatically.</li> </ul>
<ul style="list-style-type: none"> <li>• Time controls should be incorporated and operation of the whole plant should, preferably, be automatic.</li> </ul>
<ul style="list-style-type: none"> <li>• In multiple boiler installations, boilers not required to be available should be isolated on the waterside and—if safe and possible—on the gas side too. Make sure boilers cannot be fired.</li> </ul>
<ul style="list-style-type: none"> <li>• Isolation of flue system (with protection) also reduces heat losses.</li> </ul>
<ul style="list-style-type: none"> <li>• In multiple boiler installations the lead/lag control should have a change round facility.</li> </ul>
<ul style="list-style-type: none"> <li>• Where possible, any reduction in the system operating temperature should be made by devices external to the boiler, the boiler plant operating in a normal constant temperature range.</li> </ul>

#### Water and steam

<ul style="list-style-type: none"> <li>• Water fed into the boilers must meet the specifications given by the manufacturers. The water must be clear, colourless and free from suspended impurities.</li> </ul>
<ul style="list-style-type: none"> <li>• Hardness nil. Max. 0.25 ppm CaCO<sub>3</sub>.</li> </ul>
<ul style="list-style-type: none"> <li>• pH of 8 to 10 retard forward action or corrosion. pH less than 7 speeds up corrosion due to acidic action.</li> </ul>
<ul style="list-style-type: none"> <li>• Dissolved O<sub>2</sub> less than 0.02 mg/l. Its presence with SO<sub>2</sub> causes corrosion problems.</li> </ul>
<ul style="list-style-type: none"> <li>• CO<sub>2</sub> level should be kept very low. Its presence with O<sub>2</sub> causes corrosion, especially in copper and copper bearing alloys.</li> </ul>
<ul style="list-style-type: none"> <li>• Water must be free from oil—it causes priming.</li> </ul>

#### Boiler water

<ul style="list-style-type: none"> <li>• Water must be alkaline—within 150 ppm of CaCO<sub>3</sub> and above 50 ppm of CaCO<sub>3</sub> at pH 8.3.- Alkalinity number should be less than 120.</li> </ul>
<ul style="list-style-type: none"> <li>• Total solids should be maintained below the value at which contamination of steam becomes excessive, in order to avoid cooling over and accompanying danger of deposition on super heater, steam mains and prime movers.</li> </ul>
<ul style="list-style-type: none"> <li>• Phosphate should be no more than 25 ppm P<sub>2</sub> O<sub>5</sub>.</li> </ul>
<ul style="list-style-type: none"> <li>• Make up feed water should not contain more than traces of silica. There must be less than 40 ppm in boiler water and 0.02 ppm in steam, as SiO<sub>2</sub>. Greater amounts may be carried to turbine blades.</li> </ul>

<ul style="list-style-type: none"> <li>• Water treatment plants suitable for the application must be installed to ensure water purity, and a chemical dosing arrangement must be provided to further control boiler water quality. Blow downs should be resorted to when concentration increases beyond the permissible limits stipulated by the manufacturers.</li> </ul>
<ul style="list-style-type: none"> <li>• Alkalinity should not exceed 20per cent of total concentration. Boiler water level should be correctly maintained. Normally, 2 gauge glasses are provided to ensure this.</li> </ul>
<ul style="list-style-type: none"> <li>• Operators should blow these down regularly in every shift, or at least once per day where boilers are steamed less than 24 hours a day.</li> </ul>

#### Blow down (BD) procedure

<ul style="list-style-type: none"> <li>• A conventional and accepted procedure for blowing down gauge is as follows: Close water lock, Open drain cock (note that steam escapes freely), Close drain cock, Close steam cock, Open water cock, Open drain cock (note that water escapes freely), Close drain cock, Open steam cock, Open and then close drain cock for final blow through.</li> </ul>
<ul style="list-style-type: none"> <li>• The water that first appears is generally representative of the boiler water. If it is discolored, the reason should be ascertained.</li> </ul>