

or provide an equivalent opening and connect a blow-off pipe to the opening, with a gate valve or cock extending this pipe to a suitable drain or out of the basement window, providing that the basement window is lower than the point of connection to the boiler. The blow-off piping should be as large as possible, in any event not smaller than 1 in. in diameter. Many boilers have permanent surface blow-off openings and connections.

With sufficient fire in the boiler to keep the water at the boiling point, turn on the cold water supply enough to cause the water in the boiler to overflow slowly through the blow-off pipe until the surface of the water line is thoroughly skimmed of all oil and grease. One to two hours, generally, is sufficient. At intervals the water supply and blow-off valves may be closed to allow the temperature of the water to be raised.

The best results in skimming a boiler over the top can be obtained by regulating the fire and the water supply in such manner as never to allow the overflowing water completely to fill the surface blow-off pipe. The flow through this pipe should be slow, so that the grease on top of the water will float away and not be forced against the upper inside surface of the metal in the top of the boiler.

When assured that the overflowing water is free from grease, shut off the water supply valve and the gate valve in the overflow pipe and draw the water down to its correct line, using the regular blow-off at the bottom of the boiler, then close the lower blow-off, and using wood as a fuel, raise the steam pressure to at least 12 lb. Then open the lower blow-off cock wide, using care to see that the supply of water has been blown out, but do not have the fuel bed so thick that it will be difficult to dump the grates when all water has been blown from the boiler. Then open all fire and flue doors wide and allow the boiler to cool; close the drain cock; remove the surface blow-off pipe; close the opening, replace the damper regulator, and fill the boiler slowly to the water line. Then open all radiator valves, open the boiler flow and return valves, and if the thermostatic members have been removed from the return line traps, these can be replaced while the boiler is cooling. The fire then can be rekindled and the boiler may be tested for steaming.

On some boilers it may be convenient to make the temporary surface blow-off connections at the safety valve tapping; this is permissible, though it will be necessary to carry a higher water line to accomplish the skimming action. The balance of the operation will be as already described.

In boilers where a large amount of grease is present, it may be desirable to add a quantity of soda ash, which should be boiled in the boiler for at least half an hour before the blowing off operation is started. If soda ash is used it should be purchased from a wholesale drug house or drug store, for package products sold in grocery stores sometimes contain a percentage of soap, which is undesirable for this purpose.

The quantities of soda ash necessary can be determined by allowing 1 lb. for each square foot of grate area. About 3 lb. is the minimum quantity for boilers having a grate area less than 5 sq. ft. For instance, a boiler having a grate area of 10 sq. ft. requires 10 lb. of soda ash. In some cases this may be a trifle in excess of that actually required, but it is a fairly good average of what is necessary to obtain satisfactory results.

When soda ash is used care should be taken to see that all traces of this chemical are removed before the boiler is again put in operation. This can accurately be determined by testing the water occasionally with pink, not blue, litmus paper during the floating process. Litmus paper can be purchased from any drug store; the pink paper turns blue when immersed in water containing soda and retains its original color when the water is free from soda. The use of litmus paper is not feasible when natural feed water contains a high percentage of alkali. In such cases the skimming process should be continued from two to three hours, depending on the size of the boiler.

In cases where there is no water supply pressure it will be impractical to use the surface blow-off method. Under such circumstances the bottom blow-off process should be repeated many times.

On new installations it is advisable, wherever possible, to drain all condensation directly to the sewer during at least the first week of operation, thereby preventing passage of grease and dirt to the boiler from the system. The length of time during which this process should be continued depends somewhat on the amount of scale-forming material in the water, as it would be objectionable to accumulate excess scale on the heating surfaces due to the use of raw water.

PROTECTION OF BOILERS

The following physical precautions should be taken in all installations to prevent damage to the boiler:

1. There should be provided proper and convenient drainage connections for use if the boiler is not in operation during freezing weather.
2. Strains on the boiler due to movement of piping during expansion should be prevented by suitable anchoring of piping and by proper provision for pipe expansion and contraction.
3. Direct impingement of too intense local heat upon any part of the boiler surface, as with oil burners, should be avoided by protecting the surface with firebrick or other insulating material.
4. Condensation must flow back to the boiler as rapidly and uniformly as possible. Return connections should prevent the water from backing out of the boiler.
5. Low water cut-off devices which shut off the source of heat if the water in the boiler falls below a safe level are recommended for boilers fired with oil or gas.

SMOKE BREECHING AND CHIMNEY CONNECTIONS

Connections from the boiler outlet to the chimney should be air-tight and as short and direct as possible, preference being given to long radius and 45 deg., instead of 90 deg. bends. The bend at the entrance to the chimney should not project beyond the inside of the chimney and it should be pointed up from the inside of the chimney.

Where a battery of boilers is connected into a breeching each boiler should be provided with a tight damper. The breeching for a battery of boilers should not be reduced in size as it goes to the more remote boilers. Good connections made to a good chimney will usually result in a rapid response by the boilers to demands for heat.

PIPE CONNECTIONS TO BOILERS

The pipe connections which must be made to both steam boilers and hot-water heaters are:

1. Steam or flow connections from the top.
2. Return connections to the bottom.
3. Blow-off or drain connections.
4. Cold water connections for filling.

The *steam or flow connections* and also the *return connections* must be carefully designed to provide for expansion of the piping, as well as of proper size and number so as to give low outlet velocities, and uniform