

Inspection Procedure of High Risk installed boilers as per IBR, 1950

High Risk Boilers : All boilers other than Small Industrial Boilers, Vertical cross tube Boilers and Lancashire Boilers.

Procedure for Thorough Examination as per Reg 390 of IBR,1950:

- a) For examination of boiler, the boiler shall be empty and thoroughly clean in all its parts i.e., shell, tubes and furnace chambers internally as well as externally.
- b) All doors of manholes, hand holes, sight holes and cleaning plugs shall be opened. All valves and cocks comprising the boiler mounting shall be opened up and taken apart and the valves or cocks ground.
- c) Wherever there is accessibility to go inside, the Inspector should make a thorough inspection of all its internal parts through manholes provided. Before doing so, he should of course, satisfy himself that proper provision has been made for disconnecting the boiler from any other boiler under steam.
- d) If the inspector finds that proper provision for disconnection has not be made or the boiler is unreasonably hot or the boiler is not been properly cleaned or scaled, he shall decline to proceed for inspection.
- e) **Scales & Oil solvents:** The Inspector shall examine all internal surfaces to observe the action caused by the water used for, oil scale solvents, or other substances which have been in feed water. The oil or scale often leads to scaling & rupture.
- f) **Corrosion & Grooving:** The Inspector shall examine for amount of corrosion along or around the seam which may lead to grooving or cracks due to poor circulation of water all such parts should be examined carefully. Grooving along longitudinal seams is especially significant as grooving or cracks are likely to occur when the material is highly stressed. Shell plate shall be examined for pitting and wasting which may reduce the thickness.
- g) All flanging shall be thoroughly inspected and particularly the flanges of circular end plates that are not stayed. Internal grooving in the fillet of such heads and external grooving in the outer surfaces of heads concave to pressure is very common since there is slight movement in the heads of this character which produces this kind of defect.
- h) Some types of boilers have what is known as the OG or reversed flange construction in some of their parts that may be inaccessible to the eye, but the condition shall be determined by the insertion of a mirror which at a proper angle will reflect back to the eye the condition of such a place, or any other feasible manner.
- i) **Stays:** All stays, whether diagonal or through, shall be examined to note that they are in even tension. All fastened ends shall be examined to note whether cracks exist where the stays are punched or drilled for rivets or bolts and, if not found in proper tension, the Inspector should recommended their proper adjustment.
- j) **Manhole & other openings:** The manhole and other reinforcing plates, as well as nozzles or other connections flanged or screwed into a boiler, shall be examined internally as well as externally to see that they are not cracked or deformed. All openings to external attachments, such as water column connections, openings in dry pipes and openings to safety valves shall be noted to see that they are free from obstructions.
- k) **Fire surfaces-Bulging, Blistering, Leaks:** The parts exposed to fire i.e., furnace, tube internals & welding, tube sheets shall be examined for deformation which may be caused during operation by bulging or blistering or cracks. Careful observation shall be made to defect leakage from any portion of the boiler structures, particularly in the vicinity of seams and tube ends. Fire tubes sometimes blister but rarely collapse; the Inspector should look through the tubes for such defects and if they are found with a sufficient degree of distortion they should be removed.

- l) **Lap-joints, Fire cracks:** Lap-joint boilers are apt to crack where the plates lap in the longitudinal or straight seam; if there is any evidence of leakage or other distress at this point, it shall be thoroughly investigated and, if necessary, rivets removed or the plate slotted in order to determine whether cracks exist in the seam. Any cracks noted in shell plates are usually dangerous except fire cracks that run from the edge of the plate into the rivet holes of girth seams. A limit number of such fire cracks are not usually a very serious matter.
- m) **Stay bolts:** The Inspector shall test stay bolts by tapping one end of each bolt with a hammer and when practicable a hammer or other heavy tool should be held on the opposite end to make the test more effective.
- n) **Tubes:**
1. Tubes in horizontal fire-tube boilers deteriorate more rapidly at the ends toward the fire, and they should be carefully tapped with a light hammer on their outer surface to ascertain whether there has been serious reduction in thickness.
 2. The tubes of vertical tubular boilers are more susceptible to deterioration at the upper ends open when exposed to the products of combustion without water protection.
 3. The surfaces should be carefully examined to detect bulges or cracks, or any evidences or defective welds. A leak from a tube frequently causes serious corrosive action on a number of tubes in its immediate vicinity.
 4. Where short tubes or nipples are employed in joining drums or headers, there is a tendency for waste products of the furnace to lodge in the junction points and such deposits are likely to cause corrosion if moisture is present. All such places should be thoroughly cleaned and examined.
- o) **Ligaments between tube holes:** The ligaments between tube holes in the heads of all types of fire-tube boilers and in shells of water-tube boilers should be examined. If leakage is noted, it may denote a broken ligament.
- p) **Pipe connections & Fittings:**
1. The steam and water pipes, including connections to the water column, shall be examined for leaks, and if any are found it should be determined whether they are the result of excessive strains due to expansion and contraction, or other causes.
 2. The general arrangement of the piping in regard to the provisions for expansion and drainage, as well as adequate support at the proper points, shall be carefully noted. The location of the various stop valves shall be observed to see that water will not be pocketed when the valves are closed and thereby establish cause for water-hammer action.
 3. The Inspector shall determine whether there is proper provision for the expansion and contraction of such piping, and that there is no undue vibration tending to crystallize the parts subjected to it. This includes all steam and water pipe; and special attention should be given to the blow off pipes with their connections and fittings, because the expansion and contraction due to rapid changes in temperature and water-hammer action create a great strain upon the entire blow off system, which is more pronounced when a number of blow off pipes are joined in one common discharge.
 4. The freedom of the blow off connection on each boiler shall be tested whenever possible by opening the valve for a few seconds, at which time it can be determined whether there is excessive vibration. Blow off pipes should be free from external dampness to prevent corrosion.

- q) **Water column:** The piping to the water column shall be carefully noted to see that there is no chance of water being pocketed in the piping forming the steam connection to the water column. The steam-pipe should preferably drain towards to the water column. The water pipe connection to the water column must drain towards the boiler. The relative position of the water column to the fire surfaces of the boiler shall be observed to determine whether the column is placed in accordance with the Regulations. The attachments shall be examined to determine their operating condition.
- r) **Baffling-Water tube boilers:** In water-tube boilers, it should be noted, as far as possible, whether or not the proper baffling is in place. In many types of boilers the absence of baffling often causes high temperatures on portions of the boiler structure which are not intended to be exposed to such temperatures, from which a dangerous condition may result. The location of combustion arches with respect to tube surfaces shall be carefully noted.
- s) **Localization of heat:** Localization of heat brought about by improper or defective burner or stoker installation or operation creating a blow pipe effect upon the boiler, shall be condemned.
- t) **Suspended boilers-Freedom of expansion:** Where boilers are suspended the supports and setting shall be carefully examined specially at points where the boiler structure comes near the setting walls or floor.
- u) **Safety Valves:** Safety valves shall be examined to ensure there is no accumulation of rust, scale, or other foreign substances located in the casings so as to interfere with the free operation of the valves. The valves shall be tested by means of the try levers to ascertain if they are free. The steam discharged pipe is free and in accordance with the Regulations.
- v) **Boiler mountings:** Check the physical & operation condition of all the valves, automatic water level control, blowdown valve, stop valve, water gauges, pressure gauge, fusible plug, feed valves, air vent valves, automatic fire controls.

Procedure for Hydraulic Test as per Reg 379 of IBR,1950:

(a) The temperature of the water used as medium of pressure testing shall not be less than 20°C and greater than 50°C.

(b) The test pressure shall be raised gradually under proper control at all times so that it never exceeds by more than 6% of the required pressure and maintained for 30 minutes whereupon the pressure shall be reduced to maximum allowable working pressure and maintained for sufficient time to permit close visual inspection for leakage of pressure parts.

(c) After the application of the hydraulic test the Inspector shall carefully examine the boiler inside and outside and satisfy himself that it has satisfactorily withstood the test.

(d) The boiler shall satisfactorily withstand such pressure without appreciable leakage or undue deflection or distortion of its parts for at least ten consecutive minutes. If the test is not satisfactory, the working pressure allowable by calculation shall be suitably reduced, unless the owner desires to make such alterations as will enable the boiler to withstand satisfactorily the hydraulic test, in which case the boiler shall again be examined after the alterations have been made, the pressure recalculated, if necessary, and the boiler tested to the satisfaction of the Inspector.

(e) In any case in which the safe working pressure to be allowed for a boiler cannot, owing to peculiar construction of any of its parts, be determined by calculation in the ordinary way, the Inspector shall, under the direction of the Chief Inspector, subject the boiler to hydraulic test for the purpose of determining the fitness of such parts. The amount of the test pressure to be applied in such a case shall not exceed the test pressure prescribed for the least working pressure found by calculation for other parts of the boiler or the intended working pressure whichever is less.

f) Should any part of the boiler show undue deflection or indication of permanent set during the progress of the test, the pressure shall be released immediately such indications are observed. The working pressure for the part shall be 40 per cent of the test pressure applied when the point of permanent set was reached. This procedure shall apply to any boiler at any test.

g) Hydraulic tests of boilers at subsequent examination shall, except when the Competent Person expressly requires otherwise, be made after the inspection and the test pressure to be applied to

(i) Sub-critical boilers at such subsequent examinations shall be from one and quarter to one and a half times the working pressure of the boiler;

(ii) Super critical boilers, at such subsequent examinations shall be from 1¼ to 1½ times the super heater outlet pressure.”

h) When the internal construction of size of a boiler does not permit of the Inspector getting inside it or of examining closely all its parts, he shall see it tested by hydraulic pressure to one and a half times the working pressure at each inspection or the grant or renewal of a certificate.

j) The Inspector may if he considers it necessary, apply a hydraulic test to any boiler at any inspection.

m) When carrying out hydraulic test, Inspectors shall use pressure gauges supplied by the Chief Inspector.

Check list for Thorough examination:

1. Verify the engraved Boiler Registration number.
2. Condition of all pressure parts. Thickness reduction if any shall be ensured.
3. Check whether proper baffling is placed in water tube boilers.
4. Check freedom of expansion in boiler supports & settings
5. Condition of all internal surface of shell, gussets, stays provided, stiffeners on furnace, external surface of tubes shall be checked.
6. Condition of Ligaments between tube holes.
7. Any scale or oil solvents in internal or external parts of boiler.
8. Any corrosion or grooving or cracks observed in internal and external parts of boiler.
9. Condition of tubes internal for any blockages & leakages, bulges or cracks or defective weld.
10. Any distortions or bulging or blistering or leaks in furnace or fire box.
11. Condition of stay bolts or tube ends.
12. Check the physical condition of safety valves i.e., any rust, scale or other foreign substances.
13. Condition of all valves (main stop valves, feed check valves, air vent, blow down, feed inlet, water gauge mountings, water level controller, pressure gauge) & fusible plug.
14. Quality of boiler feed water (pH, TDS or hardness).
15. Working of feed water pumps.
16. Availability of boiler attendants & Boiler operation engineers.
17. Any leaks, expansions or contractions in steam pipe connections.

Check list for Hydraulic Test:

1. Check the internal and external condition of all pressure parts of boiler.
2. Check the physical condition of safety valves i.e., any rust, scale or other foreign substances.
3. Check the condition of all boiler mountings & valves (main stop valves, feed check valves, air vent, blow down, feed inlet, water gauge mountings, and water level controller) & fusible plug etc.
4. Quality of boiler feed water (pH, TDS or hardness, silica etc).
5. Working condition of feed water pumps.
6. Verify boiler operator & Boiler operation engineer qualifications & certificates.