CHAPTER IX

* REGULATIONS FOR THE REGISTRATION AND INSPECTIONS OF BOILERS

375. *The procedure to be followed in connection with applications for the registration of a boiler and with examinations of boilers under the Act shall be regulated in accordance with the provisions of this Chapter read with the relevant Sections of the Act.

376. Preparation for Inspection.—(a) At every examination of boiler or the grant of renewal of a certificate, the boiler shall be empty and thoroughly clean in all its parts. Except as provided as for in sub-regulations(f) all doors of manholes, handholes and sightholes and cleaning plugs and all caps in the leaders and mud drums of water tube boilers, all firebars, bearers, front plates, bridge plates, fire bridges brick arches, oil fuel burners and mechanical stoker fittings shall be removed. All valves and cocks comprising the boiler mounting shall be opened up and taken apart and the valves or cocks ground, when necessary, before the Inspectors' visit.

(b) Provision shall if, required by the Inspector, be made for the removal of lagging or brick-work or other concealing part and for the drilling of plates, and for verifying the pressure gauge and safety valve dimensions and weights.

(c) All smoke tubes, exterior of water tubes, smoke boxes, and external flues shall be swept clean.

* (d) Provision shall be made for the effective disconnection of all steam and hot water communications with another boiler understeam as prescribed in Chapter IXA of these Regulations. This shall be effected either by the removal of a length of pipe from the steam and feed piping or by the insertion of substantial blank flanges. Where blank flanges are employed, they shall be inserted between the flanges of the chest and the pipe attached to it. In the case of boilers fitted with welded pipe work, their effective disconnection from other boilers may be made by fitting vent pipes on the pipe work. The vent pipes which shall have bolted on flanges and not less than 2" bore shall be fitted on the pipe lengths between the boilers stop valve and the intermediate stop valve and between feed check valve and the intermediate check valve. Disconnection of the boiler from the others shall be effected by closing valves on either side of the vent pipes and then removing the blank flanges from the vent pipes.

(e) No blank flange shall be inserted between a safety valve chest and the boiler.

(f) At alternative annual inspections and subject to a minimum of three bottom rows or all tubes subject to the first pass of heat being opened up for inspection the Inspector may at his discretion relax the preparation for inspection called for under (a) above in favour of boilers having an evaporative capacity of 200,000 lbs. per hour and over, and fed either water treated to the satisfaction of the Inspectors.

*NOTE.—In accordance with sections 7 and 8 of the Act, Inspectors are required to measure and examine boilers for registration, to examine boilers for renewal certificates, to determine subject to the approval of the Chief Inspector, the pressure at which they may be allowed to work, to grant certificate therefor and generally to convey to the owners such orders as the Chief Inspector may issue.

(g) In the case of forced flow and forced circulation types of boilers, provisions shall be made for checking that proper circulation is maintained through all sections of the circuit by the flow of water.

* **377. Hydraulic test of boilers for registration.**—Every boiler shall be hydraulically tested in the presence of an Inspector or Inspecting Officer.

378. Preparation for hydraulic tests.—(a) The chest of all mounting subject to the steam pressure shall be in place and shut tight or blank flanged.

(b) The safety valves should invariably be removed and the chest opening blank flanged.

(c) The attachment for the Inspector's pressure gauge shall be in order.

(d) All doors shall be properly jointed and tightened up. The boiler shall be completely filled with water, care being taken to allow all air to escape and, if possible, a preliminary test not exceeding the working pressure of the boiler shall be taken before the Inspector's visit, to test the tightness of the joints.

* (e) When a boiler is hydraulically tested for the first time, it shall be entirely cleared of lagging or brickwork; at subsequent tests the lagging or brickwork, or portions thereof, shall be removed if required by the Inspector.

379. Procedure of hydraulic tests.—(a) Subject to the provisions of sub-regulation (e) of regulation 381, every boiler shall be hydraulically tested in the presence of an Inspector, to not less than twice the working pressure or one and a half times the working pressure plus 50 pounds per square inch whichever is less, provided that in the case of water tube boilers of fusion welded or composite construction the test pressure shall be one-and-half times the working pressure.

(b) 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.

(c)*At the first hydraulic test of a boiler prior to the issue of an original certificate deflection measurements shall be made before, during and after test of each furnace length, fire-box and flat end or other plates.

(d) 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.

(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.

*NOTE.—These deflection measurements should be entered in the Memorandum of Inspection Book before its submission to the Chief Inspector.

(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 Inspector expressly requires otherwise, be made after the inspection. The test pressure to be applied to boilers at such subsequent examinations shall be from one and a quarter to one and a half times the working pressure of the boiler.

(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.

(i) Water tube locomotive type and all tubular boilers shall be hydraulically tested at each inspection for the grant or renewal of a certificate, unless such test is waived under the orders of the Chief Inspector.

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

* (k) Except in the case of small, portable and vehicular boilers which do not require re-erection or building in brickwork, the hydraulic test of all boilers shall be conducted only after the erection of the boiler *in situ* and all boilers shall after re-erection in a position different from that in which they were last examined be hydraulically tested.

(l) A hydraulic test shall also be taken before granting an increased pressure certificate and after repairing a boiler,unless the Chief Inspector authorizes the Inspector to waive such test.

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

380. *Steam tests. —(a) Every newly registered boiler and every other boiler of which the working pressure has been altered shall, before the issue of an original or renewal certificate for such boiler, be tested under steam to the satisfaction of the Inspector.

(b) At the time of test the safety valves shall be left free and capable of being adjusted to the approved working pressure.

(c) After adjustment of the valves to the correct blowing pressure the boiler shall be tried under full steam and firing with the feed water shut off and the stop-valve closed, during which time the Inspector shall note the accumulation of pressure and other details of the test as well as the loading and adjustment of the safety valves.

In the case of water tube boilers or boilers fitted with superheaters, the feed water connection and stop valve need not be shut off and if the total safety valve area and lift are found to be adequate by calculations, the requirements

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*NOTE.—A steam test is primarily intended for the purpose of ascertaining by actual test whether the safety valves are sufficient to relieve boiler effectively of excess steam and whether they operate at the time when the maximum working pressure is reached. Inspectors should always send to the owner due notice of the date fixed for the steam test.

On completion of the test the Inspector should enter all details in the Memorandum of Inspection Books.

of the accumulation test may be assumed to have been satisfied if the valves are, or have been, so adjusetd that each blows at the pressure not exceeding the working pressure of the boiler.

(d) Before the safety valve test, the Inspector shall satisfy himself that the water gauges are in working order and that the feed apparatus is capable of supplying the boiler with sufficient water.

(e) Where the State Government does not require a person-in-charge of a boiler to hold a certificate of competency, the Inspector may, when he thinks fit, satisfy himself by questioning or by practical test whether the person-in-charge of the boiler understands the use and purpose of the water guages, the pressure guage, the safety valves, the feed water-supply and blow down.

(f) When witnessing safety valve test, Inspectors shall use the standard pressure guages supplied by the Chief Inspector unless the boiler pressure guage has, since the time of inspection, been tested and found correct with an authorized testing machine.

(g) No steam guage shall be used without a syphon filled with water between it and the boiler.

(h) When the accumulation of pressure at a steam test exceeds ten per cent of the maximum working pressure, the area of the safety valves shall be considered insufficient, and a certificate shall be refused until the safety valve area is increased.

(i) An Inspector may, when visiting a factory for any purpose, verify the correctness of the safety valves and pressure guage of any boiler under steam by comparision with his standard pressure guage.

* **381. Procedure for registration.**—(a) On receipt of an application for registration under Section 7(1) of the Act, the Inspector shall, when the boiler has been properly prepared for examination proceed to measure in complete detail all its parts, ascertain the working pressure allowed by the Regulations by making a series of calculations of the strength of the various parts, such calculations being based on his measurement and if he is satisfied with the correctness of the maker's certificate, on the dimensions and other particulars relating to the material and construction as stated therein [*vide* Section 14(1) (c) of the Act and Regulation 4]. In making his calculations he shall after examination of the material, take due account of the workmanship and details of the construction of each part. In his examination the Inspector may, if he deems necessary bore the plates or other parts to ascertain their thickness and in making his calculations he shall be guided by the requirements of Chapters IV and V of the Regulations.

* (b) If no formulae or co-efficient applicable to any part is contained in Chapters IV or V of the Regulations, the Chief Inspector shall in his discretion determine the fitness of such part.

(c) The strength of the weakest part so calculated or determined, subject to any discretionary power exercised by the Chief Inspector, shall determine the permissible working pressure of the boiler. After inspecting the boiler and ascertaining by the prescribed calculations the maximum pressure at which the boiler may be worked, the Inspector shall hydraulically test and steam-test it in accordance with requirements of Regulations 379 and 380 and a provisional order under Section 9 of the Act in Form V may be issued after the hydraulic test.

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(d) The Inspector shall enter the above particulars and dimensions of the boiler and calculations of strength of the various parts, together with details of the hydraulic and of the steam tests, in a "Memorandum of Inspection" Book (*vide* Regulation 386) which, together with all the makers' papers for the boiler, shall be submitted to the Chief Inspector with the Inspector's report under sub-section (3) of Section 7 of the Act in Form I.

* (c) Where a certificate in Form II and a Memorandum of Inspection Book in Form I are furnished by an Inspecting Authority in accordance with sub-regulation (c) of Regulation 4, the Inspector shall, on receipt of an application for registration under Section 7(1)of the Act, proceed to make such examination and measurement of the boiler as will satisfy him that the boiler is the one certified by the Inspecting Authority and that it has sustained no damage in transit for which purpose he may, if he considers it necessary, subject the boiler to hydraulic test in accordance with Regulation 379.

The Inspector shall, if he is satisfied with the condition of the boiler, accept the particulars and approved working pressure entered in Form I by the Inspecting Authority as if they had been ascertained and entered by himself and shall issue a proivisional order to enable the boiler to be worked.

He shall make such entries in respect of his examination of the boiler in the Memorandum of Inspection Book as may be required and shall submit the book and Inspecting Authority's certificate and drawing of the boiler with his report to the Chief Inspector as prescribed under sub-regulation (d).

* **382.*Engraving of registry number.**—(a) The registry number of every boiler shall, within a period of one month after the registration thereof, be cut in the front plate thereof in such position as shall be pointed out by the Inspector. The device for each State/Union Territory shall be distinguished by the following letters:—

Andaman & Nicobar Islands	A & N
Andhra Pradesh	AP
Assam	A
Bihar	BR
Delhi	D
Gujarat	GT
Himachal Pradesh	HP
Kerala	K
Laccadive, Minicoy & Amindivi Islands	LI
Madhya Pradesh	MP
Madras	M
Maharashtra	MR
Manipur	MA
Mysore	MYS
Orissa	OR
Punjab	P.I.
Rajasthan	RJ
Tripura	TR
Uttar Pradesh	UP
West Bengal	WBL

*NOTE.—Engraving slips for tracing the devices in the boiler will be supplied by the Chief Inspector; the slip should be pasted on the part of the boiler pointed out by the Inspector.

The distinguishing letters shall be engraved above a number and separated therefrom by a horizontal line two and a half inches in length. The letters and figures shall be one inch in height and of suitable breadth, provided that in the case of small boilers the letters and figures of the device may, in the discretion of the Chief Inspector, be reduced to 3/8" in height. The whole shall be enclosed in a rectangle, the upper and lower sides of which shall be three inches apart and one quarter inch clear of the top of the letters and the bottom of the figures respectively as indicated below:

BY
1234

The side lines shall be at equal distance clear from the figures. The engraving shall not be less than 1/64 inch in depth.

* (b) The engraving shall be complete and ready for verification within thirty days of the first inspection of the boiler.

(c) Boilers having registry devices differing from those prescribed herein shall have such devices altered or crossed out and engraved a new in conformity with those prescribed above. The original numbers of such boilers shall be retained in the new device, provided that in the case of boilers which were registered in a State which has since become extinct, a new number shall be given by the State where the boiler is operating. A number once allotted to a boiler shall not be used again for another boiler.

383. Measurement of heating surface.—(a) For the purpose of regulating the area of the safety valves and the amount of registration and inspection fees the "heating surface" of a boiler shall be the total surface of all plates and tubes exposed to heat on one side and in contact with water on the other measured on the water side or the fire side, whichever is larger.

(b) For Lancashire and Cornish boilers the total heating surface shall include the wetted surface of the furnaces between the end plates, the fire surface of cross tubes where fitted, and the part of the external shell below the side flue covers. In estimating the areas furnaces shall be considered as plain cylinders the area of their wetted surface shall be taken as their mean external circumference × the length of the boiler between end plates. For the shell the width of that part of the circumference below the flue covers shall be taken as =2 D, and this width+the length between end plates shall be taken as the area of shell heating surface. The part of the surface of the back-end plate exposed to heat shall be omitted from the calculation.

Example.—The formula for the total heating surface of a Lancashire boiler having plain furnaces without cross tubes is as follows:—

H.S. in square feet = 2L (3.14d + D). L is the length of the boiler between end plates in feet, d is the mean external diameter of the furnaces in feet and D is the internal diameter of the largest belt of shell in feet.

(c) For steam and water drums of water tube boilers the heating surface of the drum shall be taken as half the external mean circumference multiplied by the clear length of drum between the outer brick walls or centres of cross

boxes, as the case may be. The heating surface of the tubes shall be taken as the external surface of the tubes between the tube plates or heaters. The heating surface of the heaters shall be omitted from the calculation.

(d) For marine boilers of the fire-tube type the heating surface shall include the wetted surface of the furnaces between the tube plates (considered in the same way as for Lancashire boilers), the wetted surface of the combustion chambers (less the area of the tube holes) and the wetted surface of the tubes between tube plates. The parts of the front tube plate exposed to heat shall be omitted from the calculation.

(e) For locomotive type boilers the heating surface shall include the wetted surface of the fire-box above the foundation ring (less the area of the tube holes and the firehole and ring) and the wetted surface of the tubes between the tube plates. The smoke box tube-plate shall be omitted from the calculation.

(f) For vertical boilers of ordinary type the heating surface shall include the wetted surface of the fire-box above the foundation ring (less the area of fire hole and ring and tube holes if any) and the surface of any cross or other tubes and uptake below the lowest water level shown in the gauge glass.

(g) *For Electrode Boilers* the heating surface shall be calculated as follow

Heating surface $= \frac{E}{6}$,

Where E = the equivalent evaporation at 212°F under normal load, which $\times$ K.W.

K.W. the kilowatts absorbed at the stated voltage when the water in the boiler has a specific resistance of not less than 200 ohms per inch tube at 150 F and while the boiler is delivering its normal output of steam at its working pressure with the feed water temperature of 60°F.

(h) No deduction shall be made for stays, etc., in calculating the heating surface.

(i) For any other heating surface not provided for in the foregoing instructions the same general procedure shall be observed.

384. Boiler rating.—The boiler rating shall be the number of square feet (to the nearest whole figure) in the heating surface of the boiler as determined under Regulation 383.

385. Registration fee.—The fee required to accompany an application under sub-section (1) of section 7 of the Act shall be :—

	Rs.
For Boiler Rating not exceeding 100	70
For Boiler Rating exceeding 100 but not exceeding 300	85
For Boiler Rating exceeding 300 but not exceeding 500	100
For Boiler Rating exceeding 500 but not exceeding 700	120
For Boiler Rating exceeding 700 but not exceeding 900	140
For Boiler Rating exceeding 900 but not exceeding 1,100	160
For Boiler Rating exceeding 1,100 but not exceeding 2,000	180
For Boiler Rating exceeding 2,000 but not exceeding 4,000	210
For Boiler Rating exceeding 4,000 but not exceeding 6,000	240
For Boiler Rating exceeding 6,000 but not exceeding 8,000	270
For Boiler Rating exceeding 8,000 but not exceeding 10,000	300
For Boiler Rating exceeding 10,000 but not exceeding 12,000	360

For Boiler Rating exceeding 12,000 but not exceeding 14,000	..	..	400
For Boiler Rating exceeding 14,000 but not exceeding 16,000	..	..	450
For Boiler Rating exceeding 16,000 but not exceeding 18,000	..	..	500
For Boiler Rating exceeding 18,000 but not exceeding 20,000	..	..	550
For Boiler Rating exceeding 20,000 but not exceeding 22,000	..	..	600
For Boiler Rating exceeding 22,000 but not exceeding 24,000	..	..	650
For Boiler Rating exceeding 24,000 but not exceeding 26,000	..	..	700
For Boiler Rating exceeding 26,000 but not exceeding 28,000	..	..	750
For Boiler Rating exceeding 28,000 but not exceeding 30,000	..	..	800

Above 30,000 for every 2000, or part thereof, an additional fee of Rs 25 shall be charged :

Provided that the Chief Inspector may direct that no fee shall be payable in respect of a fresh application made in pursuance of sub-section of section 14 of the Act.

386. *Memorandum of Inspection Book.—(a) A Memorandum of Inspection Book shall be prepared for each boiler in Form I. In this book the Inspector shall enter in ink all particulars and dimensions of the boilers with the calculations for the various parts in details, particulars of hydraulic test and steam test and his inspection notes.

(b) At subsequent inspections Inspectors shall enter the dates of the inspections hydraulic tests and steam tests, when such are made with their notes thereon.

(c) Inspectors should also enter in the Memorandum of Inspection Book the general condition of the boiler and of repairs, to what extent boilers have been cleared of brick work, etc., a report of all casual visits for inspection of repairs, for inspection of main-steam-pipes, and reports on accidents, etc., in this way the Memorandum of Inspection Book will provide a useful record of the boiler's history for the information and guidance of Inspectors at subsequent inspections.

(d) On submission of the Memorandum Book to the Chief Inspector he will in the case of newly registered boilers, check all particulars and calculations and approve of the working pressure that is to be permitted. In the case of old boilers, the Chief Inspectors will examine the Inspector's notes of inspection and proposals made for repairs or reduction of pressure. A pressure once approved for the boiler should not be altered without the written authority of the Chief Inspector.

387. Registration Book.—(a) A Registration Book or copy of Memorandum of Inspection Book containing all the particulars required for registration shall be maintained in the office of the Chief Inspector in Form I and any orders passed by him regarding the boiler shall be entered in the Registration Book under his initials.

(b) The Chief Inspector should also see that the note of subsequent inspections entered in the Memorandum of Inspection Book are copied in the Registration Book.

388. Transfer of Memorandum of Inspection Book and Registration Book.—On a boiler passing from one State to another, the Memorandum of

*The Memorandum of Inspection Book should always be kept clean and up-to-date Inspection Books except when actually required by the Inspector, should be filed in the office of the Chief Inspector.

Inspection Book and the Registration Book shall, on the request of the Chief Inspector of the State to which the boiler has been transferred, be forwarded to that officer who shall take over their custody and maintain them as herein-before prescribed.

* **389. *Grant of certificate.**—A certificate for the use of a boiler shall be granted in Form VI. In the certificate shall be entered the maximum pressure at which the boiler shall be worked, the load to be placed on the safety valves or the thickness of washers or ferrules required as safeguard against overloading, the date and pressure of the last hydraulic test of the boiler and, when applicable of the main steam pipes prescribed.

390. Procedure for inspection of installed boilers.—(a) **General Instructions.**—It is essential to have every part of the boiler, that is accessible, open and properly prepared for examination, internally and externally. All boilers have openings through which an examination may be made and which for operation are closed; all such parts shall be opened whether for access to water surfaces, or heater surfaces. In cooling a boiler down for inspection or repairs, the water should not be withdrawn until the setting is sufficiently cooled to avoid damage to the boiler and when possible allowed to cool down naturally. It is not necessary, in order to comply with ordinary prudence, to remove insulation material, masonry, or fixed parts of the boiler, unless defects or deterioration peculiar to certain types or inaccessible parts of boilers are suspected and where there is moisture or vapour showing through the covering should be removed at once and a complete investigation made. Particular attention should be paid to the external parts of boilers in the way f seating blocks, especially when the situation is damp. Saddle tanks and engine fittings of locomotive type boilers should be removed to facilitate the inspection of the parts underneath at the first inspection, and at any reasonable period afterwards if the Inspector cannot otherwise satisfy himself as to the condition of those parts. Upon sufficient visible evidence or suspicion due to age or other causes, every effort shall be made to discover the true condition, even to the removal of insulating material, masonry or fixed parts of a boiler. Sometimes drilling or cutting away of parts is justifiable and necessary to positiviely determine this condition.

The Inspector should, whenever the size permits, go inside it and make a thorough inspection of all its internal parts. 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. Should he find that proper provision for disconnection has not been made or that the boiler has not been properly cleaned or scaled, or that is unreasonably hot, he should decline to proceed with the inspection and should report the facts to the Chief Inspector for orders. When a boiler is of such a size or its construction is such that the Inspector cannot go inside it, there should be sufficient sight holes or handholes provided to enable him to see the principal internal parts; if any important part of a boiler is so constructed that the Inspector cannot examine it, he should report the facts to the Chief Inspector for orders,

In the case of forced circulation and forced flow boilers which are not accessible to close visual inspection, the Inspector should, besides thorough examination, ensure by the flow of water that proper circulation is maintained through all sections of the water circuits.

*The Inspector's remarks should be as brief as possible.

(b) **Scale Oil, etc.**—Upon entering a boiler, the Inspector shall examine all surfaces of the exposed metal to observe the action caused by the use of water, oil scale solvents, or other substances which may have intentionally or unintentionally gone in with the feed water. Any evidence of oil is dangerous and immediate steps shall be taken to prevent any further entrance of oil into the boiler. Oil or scale in the tubes of water-tube boilers or on plates over the fire of any boiler is particularly bad, often causing them to rupture.

(c) **Corrosion, Grooving.**—A given amount of corrosion along or immediately adjacent to a seam is more serious than a similar amount of corrosion in the solid plate away from the seams. Grooving along longitudinal seams is especially significant as grooving or cracks are likely to occur when the material is highly stressed. Severe corrosion is likely to occur at points where the circulation of the water is poor and such places should be examined most carefully for evidences of corrosive action.

If the Inspector decides that a boiler in one or more of its parts is no longer fit for the pressure approved for it, he must without delay report his proposal for reducing the pressure to the Chief Inspector and at the same time submit his calculation for the wasted parts for check and approval of pressure.

With regard to the pitting and wasting of shell plates, the Inspector should bear in mind that shell plates may become reduce in thickness to an appreciable extent and still be stronger than longitudinal seams.

All flanging shall be throughly 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 pressurn is very common since there is slight movement in the heads of this character which produces this kind of defect. Some types of boilers have what is known as the OG or reversed flange construction in some of their parts that man be inaccessible to the eye, but the condition shall be determined by the inse.tion 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.

(d) **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 recommend their proper adjustment.

(e) **Manholes and other Openings.**—The manwhole 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, and wherever possible observation shall be made from the inside of the boiler, as to the thoroughness with which its pipe connections are made to the boiler. 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.

(f) **Fire Surfaces.—Bulging, Blistering, Leaks.**—Particular attention shall to given to the plate or tube surface exposed to the fire. The Inspector shall observe whether any part of the boiler has become deformed during operation by bulging or blistering; the former is a distortion of the entire thickness of the plate or tube where it takes place, while the latter is a lamination or separation of the plate due to foreign material being embeded in the ingot before the plate is rolled. If bulges or blisters are of such size as would seriously

weaken the plate or tube and especially when the leakage is noted coming from those defects, the boiler shall be discontinued from service until the defective part or parts have received proper repairs. Careful observation shall be made to detect 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.

(g) **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 scams. A limited number of such fire cracks is not usually a very serious matter.

(h) **Testing Staybolts.**—The Inspector shall test staybolts 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.

(i) **Tubes—Their Defects, etc.**—(*i*) 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. 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. They should be reached as far as possible either through the handholes, if any, or inspected at the ends.

(*ii*) The surfaces should be carefully examined to detect bulges or cracks, or any evidences or defective welds. Where there is a strong draft the tubes may become thinned by corrosion produced by the impingement of particles of fuel and ash, or the improper use of soot blowers. A leak from a tube frequently causes serious corrosive action on a number of tubes in its immediate vicinity.

(*iii*) 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 moisutre is present. All such places should be thoroughly cleaned and examined.

(j) **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.

(k) **Steam Pockets.**—Steam pockets on surfaces are sometimes found in new or replacement work, and wherever, this is possible or likely the Inspector should make observation and, if any are found, recommend the necessary changes.

(l) **Pipe Connections and Fittings.**—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. 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.

The arrangement of connections between individual boilers and the main steam pipes shall be especially noted to see that any change of position of the boiler due to setting or other causes, will not produce an undue strain on the piping.

It shall be ascertained whether all pipe connections to the boiler possess the proper strength in their fastenings, whether tapped into the boiler, a fitting, or flange riveted to the boiler.

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 crystalize 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. 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.

(m) **Water column.**—The piping to the water column shall be carefully noted to see that there is no chances 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.

(n) **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. These are sometimes arranged so as to cause the flame to impinge on a particular part of a boiler and produces overheating of the material and consequent danger of the rupture of the part.

(o) **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.

(p) **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. Often accumulation of ash and soot will bind the boiler structure at such points and produce excessive strains on the structure owing to the expansion of the parts under operating conditions.

(q) **Safety Valves.**—As the safety valves are the most important attachments on the boiler, they shall be inspected with the utmost caution. There

should be no accumulations of rust, scale, or other foreign substances located in the casings so as to interfere with the free operation of the valves. The setting and freedom of the safety valves should be tested preferably by raising the steam pressure to the blow-in-off point, or if this cannot be done, the valves shall be tested by means of the try levers to ascertain if they are free. Where the steam discharged from a safety valve is led through a pipe the Inspector shall determine at the time the valve is operating whether or not the drain opening in the discharge pipe is free and in accordance with the Regulations.

If the Inspector deems it necessary, in order to determine the freedom of discharge from a safety valve, the discharge connections should be removed Under no circumstances should a stop valve be permitted between a boiler and its safety valve.

(r) **Steam Gauges.**—The steam gauges on all boilers shall be removed and the Inspector shall test them and compare their readings with a standard test gauge. The readings of the steam gauges shall be observed and compared when making an inspection with steam on the boiler, where several boilers are in service connected to a common steam main. The location of the steam gauges shall be noted to see whether or not it is exposed to high temperature either externally, as would be the case if placed close to the smoke flue or other high heated part of the boiler or setting, or exposed to heat internally due to lack of protection of the gauge spring with a proper syphon or trap to prevent steam from coming in contact with the spring. The Inspector shall see that provisions are made for blowing out the pipe leading to the steam gauge.

391. Calculation of Wasted Shell.—(a) When any part is wasted and the Inspector is doubtful of its fitness for the pressure, he shall cause one or more small holes to be bored and from them ascertain the average thickness of the parts from which he can satisfy himself by calculation in accordance with the formula applicable to the part. Such gaugings and calculations he shall enter in the Memorandum of Inspection Book.

(b) In making calculations for a wasted part of a boiler shell, *e.g.*, along the line of seating blocks of a Lancashrire boiler, the Inspector shall use the following formula:—

$$\text{W.P.} = \frac{2t' \times S}{D \times F} \quad \ldots \quad \ldots \quad \ldots \quad \text{Equation (96)}$$

where t' =thickness of wasted plate, where thinnest.

S=minimum tensile strength of material of shell in lbs. per sq. in.

D=internal diameter of shell in inches.

F=factor of safety, which shall not be less than 4.

392. Repairs to Boilers and Steam Pipes.—(a) Major repairs such as fusion welded or riveted patches to shells, fire boxes and end plates of boilers and extensive building up of wasted parts of boilers permitted under these Regulations, the renewal of furnaces and end plates, parts of shell, fire boxes, girders and steam-pipes, etc., shall only be entrusted to a Repairer who can satisfy the Chief Inspector regarding the quality of welding and other repair done by his Organisation and all other minor repairs which may be determined to be minor by the Chief Inspector at his discretion may be entrusted to any repairer

Welding.—(b) The Repairer shall satisfy the Chief Inspector,—

(*i*) that the electric arc or oxy-acetylene welding sets and all other tools and plant in his possession for carrying out repairs are suitable for the work undertaken,

(*ii*) that the quality of material used conforms to the specifications that are prescribed,

(*iii*) that the supervisory and operational staff employed by him possess the necessary training and experience for the work undertaken,

* (*iv*) all welding Operators employed by the Repairer shall be required to pass the tests in regard to vertical, horizontal, overhead groove and fillet welding prescribed by the Chief Inspector,

(*v*) standard of work should be of high order and comply with all the requirements and test that may be prescribed by the Chief Inspector.

Riveting and Other Repairs.—(c) The Repairer shall satisfy the Chief Inspector,—

(*i*) that he possesses the necessary equipment and tools and engages trained and experienced workmen and staff for the work undertaken,

(*ii*) standard of work should be of a high order and comply with all the requirements and test that may be prescribed by the Chief Inspector, and all material used shall be of boiler quality.

(d) The repairs should be supervised, so far as his other duties permit by the Inspector when the fire boxes and smoke tubes of locomotive tube boilers are withdrawn, the opportunity should be taken to inspect the internal parts which are other wise inaccesible to close inspection.

(e) Repairs to boiler shells shall be effected either by patching or by removing a strip of worn or damaged plate and inserting the new strip with covering straps over the longitudinal butt ends, the strength of the riveted joints to be not less than that of the longitudinal joints of the shell.

(f) Patches for fire exposed plates shall be fitted metal to metal without joint of any description. The affected part shall be cut out, leaving the corners of the hole well-rounded. Patches shall be secured, wherever possible, properly spaced rivets with a width of plate at least equal to the diameter or rivet between the edge of the rivet hole and the edge of the plate. Where riveting is impracticable, the plate shall be secured by welt fitting countersunk headed screw pins.

(g) The thickness of a patch plate shall not be less than the original thickness of the plate which it is used to patch.

(h) Bulged or distorted furnaces of circular section may, if the bulge or distortion is not too great, be pressed back to shape.

(i) Circular furnaces of horizontal boilers that have become distorted may be suitably reinforced.

(j) Anti-collapse rings shall be of substantial section either of single or double angles bolted back to back with screw stays not less than 7/8th inch in diameter and about 7 inches in pitch passed through flat of angle and screwed into the Furnace, the ends being either rounded or riveted over on the fire

side and fitted with nuts at the other. The stay bolts shall be fitted with ferrules not less than 1 inch in depth between furnace and angle ring.

(k) Welding shall not be accepted for the repair of any part of a boiler for which welding is forbidden for a new boiler under these Regulations. Boiler shells shall not be repaired by welding beyond the filling up of a small isolated corroded or pitted part or the making up of wasted edges of openings.

(l) Cracks or grooving in dished or flat end plates of cylindrical shells or in the bends of furnace flanges in a circumferential direction may be weed out and welded.

(m) Wasted parts of circular furnaces and fire-boxes and fire exposed flat plates as in rectangular fire-boxes and combustion chambers may be cut out and be replaced by new pieces welded in or they may be built up by welding. Longitudinal cracks in circular furnaces and fire-boxes and cracks in rectangular fire-boxes and combustion chambers may be welded.

(n) No stay shall be welded.

(o) For the purposes of these Regulations renewed parts shall be deemed to be parts of a new boiler intended for use at the pressure at which the boiler under renewal is used.

(p) *Butt welding of Smoke tubes.*—Smoke tubes may be butt welded either by fusion welding, flush welding or oxy-acetylene welding, and these should be tested hydraulically at the discretion of the Chief Inspector.

393. Submission of plans of boilers.—(a) In the case of land boilers made in India or outside India for use in the States the Chief Inspector may, on receipt of a Treasury acknowledgement of the prescribed fee, receive for examination in advance the plans and the particulars of materials, design and construction of boilers so as to avoid questions arising at the examination of the finished boilers.

(b) The fee for the scrutiny of plans under sub-regulation (a) shall be on the scale prescribed in Regulation 385, subject to a maximum of Rupees Seven Hundred. When a plan which has been scrutinised and in respect of which alterations have been suggested is resubmitted for scrutiny, a separate fee on the same scale shall be payable if the plan contains alterations other than those previously suggested.

(c) The Chief Inspector shall, after examination of the plans and particulars intimate to the proposers whether he is satisfied with the design and fitness of the parts for the intended pressure and, if not, what modification is necessary therein. When plans and particulars of boilers have been approved the Inspector in making his examination shall see that the desings as approved have been carefully followed out and that the material corresponds with the approved particulars.

(d) The above procedure shall be followed in the case of extensive repairs or alterations to boilers, but no fee shall be leviable for the examination of such plans and particulars.

STEAM PIPES

* **394. Inspections of Steam Pipes.**—(a) Steam pipes shall be inspected and hydraulically tested before erection in place, the test pressure to be that prescribed in the Standard Conditions for steam pipes. A certificate from the Inspecting Authority or a recognised maker in Form IIIA stating that this has been done may be accepted. If the Inspector is satisfied with the test, the pipes may be erected in position; at the steam test of the boiler he shall examine them under steam pressure. No separate certificate for the steam pipes shall be issued.

* (*b*) At subsequent inspections of the boiler or at any other time, the Inspector may make an external inspection of the steam-pipes and for this purpose may require a part of the lagging at the flanges to be removed, and the pipe made bare. If as a result of this inspection the Inspector is of opinion that the pipes or any portions of them are in an unsatisfactory condition, he shall report the matter to the Chief Inspector, who may require the whole of the lagging to be removed and may require any pipe or pipes to be hydraulically tested. The test pressure at such hydraulic test shall be not less than twice the working pressure of the boiler.

* (*c*) The date and hydraulic pressure to which steam pipes were subjected shall be entered in the certificate for the boiler and such entries shall be continued from time to time in the renewal certificates for the boiler.

395. Submission of plans of steam-pipes.—(a) Plans of steam pipes shall be submitted with the pescribed fee to the Chief Inspector before construction or at the time of registration of the boiler for his decision whether the pipes and their arrangement comply with the Regulations.

(b) The fee required under sub-regulation (a) shall be at the rate of Rs. 5.00 per 30 metres (100 ft.) of piping or part thereof inclusive of all fittings, excepting fittings like de-superheaters, steam receivers, feed heaters and separately fired super heaters. For any fittings like de-superheaters, steam receivers and separators, the fee shall be Rs. 50.00 for each such fittings.

395A. INSPECTION FEES FOR BOILERS AND PARTS THEREOF CONSTRUCTED IN INDIA

(1) The inspection fee for boilers shall be calculated on the following bases:

(*i*) at three times the registration fee for a boiler of riveted construction,

(*ii*) at four time the registration fee for a boiler of welded construction.

(2) Fees for inspections of boiler scantlings shall be charged as under:—

(*i*) up to 10 square feet (0.929 sq. metre) of outside surface—nil.

(*ii*) above 10 square feet (0.929 sq. metre) of outside surface—one half of the registration fee of the boiler for which the part is intended.

(3) Fees for inspection of tubes shall be charged at Rupees Twenty only per metric ton or a fraction thereof.