PROVINCE OF ONTARIO

REGULATIONS

FOR THE

CONSTRUCTION AND INSPECTION

OF

BOILERS

Issued by Authority of the
HON. MINISTER OF PUBLIC WORKS.

TORONTO:
Printed and Published by L. K. CAMERON, Printer to the
King's Most Excellent Majesty
1913

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WILLIAM BRIGGS
PRINTER AND PUBLISHER
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INDEX.

I.—General.

	Section
Boilers not complying with regulations	1
Unregistered boilers	2
New fittings on old boilers	3
Repaired or rebuilt boilers	4
Fees for examination of drawings and specifications	5
Fees	6

II.—Registration of Design.

Drawings and specifications	7
Identification	8
Affidavit to accompany boiler	9

III.—Design.

Cylindrical portions of boilers	10
Thickness of plates	11
Maximum diameter of externally fired boiler	12
Reinforcing plates	13
Reinforcing plates where brackets are attached	14
Manholes	15
Location of manholes	16
Manhole and manhole doors, bolts and bridges	17
Handholes and washout plugs	18
Handhole and washout holes in locomotive type	19
Firehole doors	20
Handholes in vertical boilers	21
Minimum diameter of stay	22
Screwed stays to have substantial heads	23
Maximum working stress on stays	24
Working stress on studs and bolts	25
Domes on cylindrical parts of boilers and openings for other purposes	26
Maximum working pressure allowed on a boiler	27
Efficiency of ligament	28
Factors of safety	29
Maximum pitches for riveted joints	30
Lap outside rivets	31
Minimum diameter of rivet	32
Rivet heads	33
Efficiency of riveted joints	34

	Section
Single riveted lap joint	35
Double riveted lap joint	36
Treble riveted lap joint	37
Double riveted butt joints with equal straps and equal pitch of rivets in each row	38
Treble riveted butt joints with unequal straps and each alternate rivet omitted in outer row	39
Distance between rows of rivets	40
Butt straps with full number rivets in all rows	41
Double butt straps for joints with unequal straps when every alternate rivet is omitted in outer row	42
Longitudinal seams	43
Cylindrical heads either dished or flat	44
Radius to which head is bumped	45
Concave heads	46
Flat heads	47
Area of head to be stayed	48
Pitch of stays in head	49
Maximum stress allowed on stays	50
Diagonal stays	51
Rivet area for stays	52
Minimum diameter of rivets in stays	53
Gusset stays	54
Flat surfaces	55
Unequal pitch	56
Irregular staying	57
Tube sheets	58
Support given by the tubes	59
Minimum size of ligaments	60
Compressive stress on tube sheet	61
Belly stays	62
Internally fired furnaces or parts of boilers (other than ordinary fire tube) subjected to compression	63
Adamson type furnaces	64
Corrugated furnaces	65
Truncated cones	66
Crown sheets in locomotive types or other boilers	67
Flat crown sheets in traction and portable boilers	68
Girder stays on crown sheets	69
Water space between girder and sheet	70
Wagon tops	71
Backheads of locomotive type boilers	72
Throat sheets	73
Hydrostatic tests	74
Tensile strength	75
When special formula is necessary	76

Section

IV.—Material.

Plate maker's name and tensile strength 77
Steel plates 78
Qualities of plates and limits of same 79
Firebox steel 80
Rivet steel 81
Wrought iron plates and bars 82
Braces, stays and stay bolts 83
Stay bolt bending test 84
Tubes 85
Malleable iron castings 86
Rejection of material 87
Cast iron 88
Steel castings 89

V.—Workmanship.

Good Workmanship essential 90
Plates 91
Caulking 92
Butt straps 93
Holes in sheets 94
Scarfing 95
Holes to be fair 96
Drift pins 97
Templets 98
Rivets 99
Flanging sheets 100
Tubes 101
Tube sheets 102
Stays 103

VI.—Fittings.

Quality and strength 104
Mode of attaching 105
Safety valves 106
Area of valve 107
Testing valves 108
Twin valves 109
No cast iron seat allowed 110
Maximum and minimum diameter of valve 111
Location of valve, escape pipe, etc. 112
Fusible plug 113
Steam gauge 114
Dial of gauge 115
Syphon and cut-out cock 116
Inspector's test gauge connection 117

	Section
Gauge glass	118
Gauge cocks	119
Water column and connections	120
Feed water supply	121
Feed arrangements	122
Stop valves on steam mains	123
High pressure fittings	124
Steam mains	125
Drains	126
Blow off pipes and valves	127
Side lugs and settings for horizontal cylindrical boilers	128
Back arch	129
Boiler room doors	130

VII.—Inspection.

The Steam Boilers Act	131
Records of inspection and annual report	132
Sale or exchange of boilers to be accompanied by inspector's certificate	133
Boilers under construction or repair may be examined	134
Inspector to have access for inspection	135
Boilers to be constructed according to departmental regulations	136
Provision of fusible plug	137

Section
.. 118
.. 119
.. 120
.. 121
.. 122
.. 123
.. 124
.. 125
.. 126
.. 127
al
.. 128
.. 129
.. 130

.. 131
.. 132
by
.. 133
be
.. 134
.. 135
al
.. 136
.. 137

An Act

Respecting

Steam Boilers

Assented to 6th May, 1913.

HIS MAJESTY, by and with the advice and consent of the Legislative Assembly of the Province of Ontario, enacts as follows:—

Short title.

1. This Act may be cited as "*The Steam Boiler Act.*" 10 Edw. VII., c. 98, s. 1.

Interpretation.

2. In this Act and the Regulations,—

"Inspector."

(*a*) "Inspector" shall mean an Inspector appointed by the Lieutenant-Governor in Council under and for the purposes mentioned in this Act;

"Minister."

(*b*) "Minister" shall mean the Minister of Public Works;

"Regulations."

(*c*) "Regulations" shall mean regulations made under the authority of this Act by the Lieutenant-Governor in Council;

"Steam boiler."

(*d*) "Steam Boiler" shall mean *and include* a boiler used for generating steam for heat or power purposes, and every part thereof or thing connected therewith, and apparatus and things attached to or used in connection with any such boiler, but not

(i.) A boiler in a private residence, apartment house, office building, church, hotel, or public building used exclusively for heating purposes, and provided with a device approved by the Minister, limiting the pressure carried to fifteen pounds to the square inch, nor

(ii.) A portable boiler, rated at 25 horse power or under, or a boiler used exclusively for horticultural or agricultural purposes.

3. Upon the recommendation of the Minister of Public Works the Lieutenant-Governor in Council may make regulations,— Lieutenant-Governor to make regulations as to construction, etc., of steam boilers.

(*a*) Respecting the construction of steam boilers;

(*b*) Prescribing specifications for the construction of steam boilers, including the material to be used, the method and order of construction, the tests to be applied during and after construction;

(*c*) For the inspection of every steam boiler during its construction and before it is removed from the place of construction; and

(*d*) Generally respecting such other matter as may be deemed proper to secure a uniform standard of strength, safety and efficiency in the construction of steam boilers. 10 Edw. VII. c. 98, s. 3. *Amended.*

When to come into effect.

4. The Regulations shall be published in the *Ontario Gazette* and shall come into force and take effect at a date to be named by Proclamation. 10 Edw. VII. c. 98, s. 4.

Note.—The rules, regulations, etc., were proclaimed on 29th January, 1913 to come into force on 1st July, 1913.

Appointment of Inspectors.

5.—(1) The Lieutenant-Governor in Council may appoint Inspectors of steam boilers for the purposes of this Act and for the enforcement of the Regulations, and may designate one of them to be Chief Boiler Inspector.

(2) The Minister may employ any boiler insurance company registered in the Department of Insurance, or any Inspection Company engaged in the inspection of steam boilers, to make any inspection of steam boilers during their construction, required by the Regulations, and the company making such inspection shall report upon the same within fourteen days thereafter to the Chief Boiler Inspector.

Inspectors not to be agents for machinery.

6. No person shall be appointed or shall hold office as Inspector who is directly or indirectly interested in the manufacture or sale of steam boilers or steam machinery.

Oath of office to be taken.

7. Every Inspector appointed under the provisions of this Act shall, before entering upon the performance of his duties, take and subscribe an oath that he will faithfully and impartially perform the duties of his office.

Inspectors may enter premises.

8. For the purpose of seeing that the provisions of this Act, and of the Regulations are complied with, an Inspector may at any reasonable hour enter upon any lands or into any building where any steam boiler is under construction, alteration or repair.

Obstructing inspector.

9. Any person interfering with or obstructing any Inspector in the performance of his duties under this Act shall incur a penalty not exceeding $50.

Power for Inspector to summon witnesses.

10.—(1) An Inspector may by notice in writing require the attendance before him, at a time and place named in the notice, of any person and may

examine such person either alone or in the presence of any other persons as he may think fit as to any matter connected with the construction, alteration or repair of a steam boiler or its removal from any place in which it has been constructed, altered or repaired.

To administer oath.

(2) For the purposes of subsection 1 the Inspector may administer an oath to any person to be examined by him.

Penalty for neglect to attend.

(3) Every person who wilfully neglects or refuses to attend before the Inspector after receiving notice so to do, or refuses to be sworn or to give evidence before the Inspector, or to answer any question put to him by the Inspector touching the matters mentioned in Subsection 1, shall incur a penalty of $25.

Inspection certificate.

11.—(1) Upon completion of his inspection the Inspector shall issue to the owner or manufacturer of the boiler an inspection certificate; and

Fee.

the owner or manufacturer shall pay the Inspector a fee of $5 for such inspection and the issue of such certificate.

(2) Any owner or manufacturer neglecting or refusing to pay the Inspector such fee shall incur a penalty not exceeding $20. Penalty for refusal to pay fee.

12.—(1) Any person who is dissatisfied with the action of an Inspector or with a certificate of inspection issued by him, may within one week after the inspection appeal to the Minister, who may thereupon cause another inspection to be made, by one or more competent inspectors, who shall report to him, and the decision of the Minister shall be final.

(2) Any expenses occasioned by the appeal and second inspection shall be paid as determined by the Minister.

13. All fees paid and all penalties recovered under this Act or the Regulations shall be paid to the Treasurer of Ontario. Application of fees and penalties.

14. The penalties imposed by or under the authority of this Act shall be recoverable under *The Ontario Summary Convictions Act*. Recovery of penalties. 10 Edw. VII. c. 37.

15. This Act shall not apply to

(*a*) A new boiler in the possession of the manufacturer, or of a dealer in steam boilers on the 1st day of July, 1913, nor a boiler under construction on that date; nor

(*b*) A second hand boiler in the possession of the manufacturer or of a dealer in steam boilers on that date, unless the same is re-built or extensively altered after that date.

10 Edw. VII. c. 98 repealed.

16. Chapter 98 of the Act passed in the 10th year of the reign of His late Majesty King Edward the Seventh is repealed.

J. M. GIBSON.

CANADA.

PROVINCE OF ONTARIO.

GEORGE THE FIFTH by the Grace of God, of the United Kingdom of Great Britain and Ireland and of the British Dominions beyond the Seas, KING, Defender of the Faith, Emperor of India.

To all to whom these presents shall come, or whom the same may concern,

GREETING.

J. J. FOY,
Attorney General.

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PROCLAMATION.

WHEREAS under the provisions of an Act respecting Steam Boilers, being Chapter 98 of the Statutes of the Legislative Assembly of the Province of Ontario, passed in the tenth year of His late Majesty's Reign, it is amongst other things enacted that upon the recommendation of the Minister of Public Works, the Lieutenant-Governor-in-Council may make such rules, regulations and specifications as may be deemed proper respecting the construction of steam boilers, including the materials to be used, the method of construction, the tests to be applied, the inspection of the boiler during its construction and before it is permitted to leave the place of construction, and generally such other matters as may secure a uniform standard of strength, safety and efficiency, and that the rules, regulations and specifications shall be published in the ONTARIO GAZETTE, and shall come into force and take effect at a date to be named by Proclamation.

AND WHEREAS it has appeared expedient to Our Lieutenant-Governor-in-Council that a Proclamation should now issue naming the first day of July, 1913, as the day on, from and after which the following and accompanying rules, regulations and specifications shall come into force and have effect.

NOW KNOW YE that, having taken the premises into Our Royal Consideration, We, by and with the advice of the Executive Council of Our Province of Ontario and in the exercise of the power in us vested in this behalf by the said in part recited Act, or otherwise howsoever, DO by this Our Royal Proclamation, HEREBY PROCLAIM AND DECLARE that the following and accompanying rules, regulations and specifications dated the 21st day of January, 1913, respecting the construction of steam boilers, including the materials to be used, the method of construction, the tests to be applied, the inspection of the boiler during its construction and before it is permitted to leave the place of construction, and generally such other matters as may secure a uniform standard of strength, safety and efficiency, shall come into force and have effect on, from and after the first day of July, 1913.

OF ALL WHICH PREMISES all Our loving subjects and all others whom it doth or may in any wise concern are hereby required to take notice and govern themselves accordingly.

IN TESTIMONY WHEREOF We have caused these Our Letters to be made Patent, and the Great Seal of Our Province of Ontario to be hereunto affixed.

Witness:

HIS HONOUR SIR JOHN MORISON GIBSON, Knight Commander of Our Most Distinguished Order of St. Michael and St. George, a Colonel in Our Militia of Canada, etc., etc., Lieutenant-Governor of Our Province of Ontario, at Our Government House, in Our City of Toronto, in Our said Province this 15th day of February, in the year of Our Lord one thousand nine hundred and thirteen and in the third year of Our Reign.

By Command.

W. J. HANNA,
Provincial Secretary.

REGULATIONS

FOR THE

CONSTRUCTION AND INSPECTION OF BOILERS.

I. GENERAL.

The following regulations for the construction and inspection of boilers have been prescribed by the Lieutenant-Governor-in-Council in accordance with the provisions of section 3 of The Steam Boilers Act, said regulations to be in force from and after the first day of July, 1913.

1.—Boilers Not Complying with Regulations.

All boilers that do not comply in every particular with these regulations will be penalised by the inspectors by a suitable reduction in pressure allowed, their working pressure being calculated from the formulæ in the following rules with such additions as the inspector may deem safe in accordance with the provisions of The Steam Boilers Act.

2.—Unregistered Boilers.

Boilers brought into the Province after July 1, 1913, for which drawings and specifications have not been submitted and approved nor affidavits filed will be penalised by a deduction of at least ten per cent. from the working pressure as calculated from the formulæ in the following regulations.

3.—New Fittings on Old Boilers.

All new safety valves, steam and water gauges, fittings and parts of boilers attached to boilers after the coming into force of these rules must be such as are sanctioned by the regulations.

4.—Repaired or Rebuilt Boilers.

In the case of repaired or rebuilt boilers the Department wish to encourage good workmanship and the use of good material. With that end in view the inspectors have been instructed to give a substantial advantage to boilers which have been open for inspection by an inspector appointed by the Department during the whole period of such repairing or rebuilding and have been duly inspected by such inspector before leaving the shop and for which a certificate has been issued.

5.—Fees for Examination of Drawings and Specifications.

The following shall be the scale of fees for examining designs or revisions of designs of boilers and accessories for approval and registration:

Design and specification of each complete boiler	$10 00
Piping for power plant from $5.00 up, according to size of plant.	
Boiler accessories, such as safety valves, stop valves, steam gauges, etc., for each design	3 00

The proper amount should be forwarded with the drawings and specifications of each boiler or part of boiler submitted for approval.

6.—Fees.

The fees payable under this Act shall be paid into and form part of the consolidated revenue fund.

II. REGISTRATION OF DESIGN.

7.—Drawings and Specifications.

Before commencing work on any boiler to be built under these regulations three drawings of the same with specification form in triplicate must be submitted to the Department for approval of the pressure and arrangement of the boiler which must comply in all cases with these regulations and the Act.

This applies also to designs for safety valves and other fittings. Approval or corrections will promptly be given or pointed out in the order as applications are received by the Department and the manufacturers advised accordingly.

Each drawing must show all details and complete dimensions, the material and sizes also being given on specification.

To prevent delay any manufacturer may submit for approval standard designs of manufacture which when finally approved will be given registration numbers for the Province and from which boilers may be made by that manufacturer in any number, full reference being made to the registration when sworn construction certificates are sent to the Department concerning such boilers. Any

new design submitted for approval after any change in these regulations has been made must be in accordance with such change.

Three drawings or blue prints of each design submitted must accompany an application for its approval, each having a blank or white space on it five by four inches in size; one of these drawings will be returned to the manufacturer. Changes in design necessitate submission of new drawings and specifications for approval and fresh registration.

The specifications to accompany drawings should be sent in on the regular form, a supply of which may be obtained from the Department.

When a design is approved the Department will allot to the manufacturer a registration number for that particular design.

It is to be understood that the approval of drawings will not exonerate the manufacturer from any responsibility in connection with boilers and fittings constructed according to these regulations.

8.—Identification.

Every boiler built under these regulations shall be stamped on the plates of the boiler on the place hereinafter indicated as follows in figures at least one-quarter inch in size:

(*a*) Builder's name and shop number of boiler;

(*b*) Provincial letter and registration number of design;

(*c*) Lowest tensile strength of any shell plate in the boiler with "S" for steel and "I" for iron;

(*d*) The name of the plate manufacturer and quality of plate;

(*e*) The date of construction, thus: Day of month, numerical order of month, last two figures of year.

A sample stamping would be as below, it bein stamped legibly and fully into the plate of th boiler itself (not the smoke box):

(*a*) Smith Boiler Company. 23456.
(*b*) O.555 (for Ontario).
(*c*) 55000.S.
(*d*) Carnegie "Flange."
(*e*) 26.10.13.

The location of stamping shall be as follows:

On horizontal return tubular boilers, on centr of front head above tubes.

On portable and locomotive types, on right si of fire door clear of attachments.

On water tube boilers, on the end of steam dru above manhole door.

On internally fired boilers with circular fu naces, on right side of fire doors, if practicable.

On vertical boilers, on right side of fire doo

For boilers where location is not practicable above it must be indicated in specification.

9.—Affidavit to Accompany Boiler.

When any boiler enters the Province it shall accompanied by an affidavit of the boiler sh foreman under whose supervision the boiler w built fully filled out and detailed as per form Appendix B, page 88, of these regulations, whi form will be supplied by the Department on quest. When the boiler is delivered to a purchas the particulars of sale showing the name and a dress of the purchaser must be filled in on th form by the sales agent and the form forward to the Department.

III. DESIGN.

10.—Cylindrical Portions of Boilers.

Cylindrical portions of boilers, such as shells, barrels, domes, drums or reservoirs shall be made as nearly as possible truly cylindrical.

All surfaces formed to a true circular curve, excepting surfaces otherwise provided for, shall be calculated in a similar manner to cylindrical shells, but when they or other parts are not so made, or are parts of true cylinders of different radii, they must be treated as flat surfaces and stayed accordingly, and in any case at the change of curvatures.

11.—Thickness of Plates.

The minimum thickness of any plate used in the construction of a boiler under these regulations shall be ¼ of an inch and in all cases the thickness of boiler heads having a diameter up to 40 inches shall be not less than 5-16 inch; diameters over 40 inches and up to 52 inches, not less than 8 inch; diameters over 52 inches and up to 60 inches, not less than 7-16 inches and not less than 16 inch additional thickness for every 6 inches additional diameter for boilers above 60 inches ameter.

The thickness of all plates in cylindrical portions of shells or in drums shall be alike, and that quired for the working pressure of any part according to formulæ hereafter given, but must not less than ¼ inch.

The minimum thickness of plates in stayed surface construction shall be 5-16 of an inch.

12.—Maximum Diameter of Externally Fired Boiler.

Seventy-two inches shall be the maximum diameter of all externally fired boilers.

13.—Reinforcing Plates.

(*a*) For standard pipe connections below the water line exceeding ¾ inch diameter, and not exceeding 2 inches in diameter, and for standard pipe connections above the water line exceeding 1 inch in diameter and not exceeding 2 inches in diameter, the openings in the boiler shall be reinforced with a plate securely riveted to the shell, the threads being made continuous and full size through both plates, and the pipe fitting tightly in both.

(*b*) Instead of the reinforcing plates required by the above clause, forged steel flanges, threaded to receive the pipe, may be riveted to the outside of the shell, except at the blow-off outlet. The threaded portion for pipes up to 1¼ inches bore shall have a depth of not less than 1 inch; for pipes 1½ inches bore the depth shall be not less than 1¼ inches; and for pipes up to 2 inches bore the depth shall be not less than 1½ inches. The thickness of flange for pipes up to 1¼ inches bore shall be not less than 5-16 inch, and for pipes exceeding 1¼ inches bore and up to 2 inches bore shall be not less than ⅜ inch thick. Openings in boiler shell shall not be more than ¼ inch greater in diameter than the bore of the flange.

(*c*) For all connections exceeding 2 inches in diameter, except at blow-off outlet, flanged nozzles riveted to the boiler must be used. For working pressures exceeding 100 pounds per square inch the nozzles must in all cases be of steel. In tra

tion boilers, steel flange bases riveted to the boiler may be used instead of flanged nozzles for connections up to and including 3 inches in diameter.

(*d*) Other openings in cylindrical parts of boilers, drums or other parts shall be reinforced in all cases where their measurement exceeds 2½ inches by 3½ inches.

(*e*) All openings in flat or cambered surfaces of boilers, drums or other parts exceeding 2½ inches by 3½ inches shall be reinforced or flanged inwards.

(*f*) All reinforcing rings or plates must be fitted closely to the plates they reinforce, and must be of at least the same thickness.

14.—Reinforcing Plates Where Brackets are Attached.

(*a*) In all cases where brackets or other fixtures subjected to any working strain are attached to a traction or portable boiler the plates to which these brackets are attached shall be reinforced with plates of the same thickness as the outer plates and properly riveted together, the outer rows of rivets attaching reinforcing plates must be outside the bracket. All brackets shall be properly fitted (without white metal or other filling) to the plates, flat or curved, with stud holes drilled to suit the holes in brackets, which must be drilled to templets and the studs attaching same shall be tapped through both plates where reinforced. (No cap screws will be allowed.)

(*b*) When the shell plates of a traction or portable boiler are at least 20 per cent. in excess of the thickness required by these Regulations for the actual working steam pressure, and provided always that the said plates are not less than one-half an inch in thickness, and that the studs

attaching the brackets or other fittings referred t
in this section have not less than twelve thread
per inch, the reinforcing plates under bracket a
tachments may be omitted.

15.—Manholes.

All boilers shall be provided with the prescribe
number of manholes of standard size, strengthene
with reinforcing ring cut from boiler plate of a
least the same thickness as the shell and equa
exclusive of rivet holes, to the area of section cu
from shell in line with its longitudinal axi
riveted around the manhole opening.

A flange formed inwards on the reinforcin
plate to receive the door is required. The rei
forcing plate must be placed on the inside
boiler, except in boilers under 42 inches diamete
when it may be placed outside.

All manholes in flat surfaces must be flange
from solid plate inwards.

All manhole flanges must have a ring not le
than ¾ x 1½ inches securely shrunk arou
flange, which shall be faced to form a joint.

The rivets holding reinforcing rings to she
must be sufficient for caulking purposes, but the
area in no case shall be less than 120 per cen
above the net sectional area of part cut from she
in line of its longitudinal axis.

16.—Location of Manholes.

There shall be a standard manhole in the upp
part of the shell of a fire-tube boiler 42 inches a
above in diameter, excepting vertical fire-tu
boilers, where the furnace or tubes prevent acce
to the interior of the boiler.

Horizontal cylindrical boilers 48 inches in diameter and upwards shall contain two manholes not less than 10 x 15 inches in the clear, one in the front head below the tubes and one in the shell above the tubes. In boilers 66 inches and above in diameter manholes shall be 12 x 16 inches in the clear.

17.—MANHOLE AND HANDHOLE DOORS, BOLTS AND BRIDGES.

Manhole and handhole doors must be well fitted and faced off to form a good tight joint. The possible lateral motion must in no case exceed ⅛ inch. Cast iron manhole doors of good design and when of ample thickness and a good quality of material may be used for boilers carrying a pressure not exceeding 100 lbs. Doors not exceeding 12 x 16 inches to be made of steel plate at least 1 inch thick, or of approved pressed steel design ⅝ inch thick, for pressures from 100 pounds to 125 pounds pressure inclusive; and from 125 pounds to 200 pounds pressure inclusive, these shall not be less than 1⅛ inches and 11-16 inch thick respectively; if two flat plates riveted together are used for manhole doors, the plate forming the flange must not be less than ¾ inch thick and the combined thickness of the two plates must not be less than 1 inch and 1⅛ inches respectively. The plates must be well riveted together.

(*a*) Manhole doors are to be provided with two bolts at least 1¼ inches in diameter, having a shoulder on the outside, screwed through the door and riveted to the inside. For pressed steel doors less than ¾ inch thick the bolts must be screwed through the door, nutted and riveted over.

(*b*) For working pressures up to 100 pounds inclusive cast iron handhole doors may be used when of good design and material, and may be made of cast malleable for pressures exceeding 100 pounds when not over 2½ x 3½ inches. When exceeding 2½ x 3½ inches and a pressure of over 100 pounds is carried steel plate doors must be used; the thickness of door flange to be at least the thickness of surrounding shell plate.

(*c*) Handhole door bolts must be not less than ¾ inch in diameter for doors 2½ x 3½ inches, and at least ⅞ inch when exceeding that size, all bolts being screwed through the door and riveted to the inside.

(*d*) All bridges used for manhole and handhole doors must be wrought iron or of pressed steel design and of ample strength to withstand the stress put upon them. Bridges used for doors not exceeding 2½ x 3½ inches may be cast malleable iron.

18.—Handholes and Washout Plugs.

All cylindrical horizontal boilers less than 42 inches in diameter must be provided with a handhole in each head below the tubes; not less than 3 inches by 4½ inches, which must be flanged inwards or reinforced.

All other types of boilers must be provided with sufficient mudhole or handhole and washout plug openings to provide for properly cleaning and inspecting every part of the boiler. When mudhole openings are threaded for plugs the plugs must in all cases be of brass.

19.—Handhole and Washout Holes in Locomotive Type.

A locomotive type boiler shall be provided with sufficient handholes and washout plugs to allow the whole of the interior to be inspected and for washing out.

In no case shall there be less than six handholes or less than twelve such openings in all, the whole to be located as approved in design and due regard had to facility of access when the machinery or other attachments are mounted on the boiler, great care being given to secure the best arrangement for cleaning the interior of the boiler. Wet bottom boilers must have a plug in the lowest part of shell and have a drainage tube in bottom to drain ashpan.

20.—Firehole Doors.

Firehole in portable, traction and locomotive firebox boilers and in vertical boilers exceeding 30 inches in diameter must not be less than 10 by 15 inches, or equivalent area if the maximum dimension is not less than 14 inches, in the clear, to allow for examination of firebox.

21.—Handholes in Vertical Boilers.

All vertical firetube boilers shall have not less than 7 openings for cleaning out purposes, located as follows: One at the water line 4 x 6 inches, three in line with the lower tube sheet, two at bottom of water leg, one small plug under the mudhole door; boilers exceeding 36 inches in diameter shall contain two 4 inch x 6 inch handholes located at the water line and spaced opposite to one another.

22.—Minimum Diameter of Stay.

No stay less than ⅞ inch as measured over threads shall be used in the construction of a boiler.

23.—Screwed Stays to Have Substantial Heads.

Screwed stays (not fitted with nuts) must be thoroughly fitted to the sheets, be well set up, and the ends well riveted over to form good substantial heads, but standing not more than 2½ or less than 2 threads above the sheet at their centers. The number of threads per inch shall not exceed 12 or be less than 11 in any plate or shell in the boiler except for standard steam and water pipe sizes. The use of the Whitworth type of thread is recommended.

24.—Maximum Working Stress on Stays.

The maximum working stress on stays shall be as follows:

(*a*) Iron—For screw stays and other stays which have been welded 5,000 pounds per square inch net section will be the maximum stress allowed. For screw stays and other stays not welded, 7,000 pounds per square inch net section will be the maximum stress allowed.

(*b*) Steel—For screw stays and other stays less than 1½ square inches net sectional area 8,000 pounds per square inch will be the maximum stress allowed. For all other stays 9,000 pounds per square inch net section will be the maximum stress allowed.

(*c*) Steel stays may be upset at ends but not welded in any way. Longitudinal stays must be secured to heads by nuts and washers and

eted over on the sheets, excepting that where e ends of longitudinal stays if secured by nuts d washers, would be exposed to the action of e fire; as in the case of the back ends of the ngitudinal stays below the flues of horizontal bular boilers, they may be attached to angles, y plates or tee bars riveted to the boiler head d having an ample water space between them d the head of the boiler.

Holes in sheets for stays not screwed into or eted to plates must be not more than 1-16 of an h larger than the diameter of the stay and to finished by reaming or by rose cutter, or lled.

Stays must be arranged so as to admit of free cess to the interior of the boiler.

25.—Working Stress on Studs and Bolts.

Maximum stress on studs and bolts used for me covers, flanges and accessories will be taken follows:

Dia. of Bolt or Stud.	Allowable Stress.
¾ inch.....	3,000 pounds per sq. inch.
⅞ "	4,000 " " " "
"	5,000 " " " "
1⅛ "	5,500 " " " "
1¼ "	6,000 " " " "
1⅜ "	6,500 " " " "
1½ "	7,000 " " " "

Studs screwed into plain flanges, etc., must be pped to a depth of not less than the diameter of e stud.

26.—Domes on Cylindrical Parts of Boilers and Openings for Other Purposes.

Any opening for domes, manholes, handholes, or for other purposes on shells or cylindrical parts of boilers must have its shorter axis in line with the longitudinal axis of same, and when that is over 2½ inches be reinforced by a plate riveted after careful fitting to the shell, around the opening. The reinforcement must be equal in cross section and strength exclusive of rivet holes to the section of plate cut out of shell or covered by the dome in line with its longitudinal axis. The combined area of rivets securing the reinforcement to shell must be exclusive of those necessary to hold dome to shell, 120 per cent. in excess of the area of section so removed or measured.

27.—Maximum Working Pressure Allowed on Boiler.

The maximum working pressure to be allowed on the shell of a boiler constructed of steel or wrought iron shells or drums shall be determined from the minimum thickness of the shell plates, the lowest tensile strength stamped on the plate by the plate manufacturer, or as established by authoritative test, the efficiency of the longitudinal joint, the inside diameter of the outside course, and the lowest factor of safety allowed by these rules, the formula being:

$$B = \frac{2T \times S_t \times K}{D_r \times F}$$

B = Maximum allowable working pressure in pounds per square inch.

T = Minimum thickness of shell plate in inches.

S = Tensile strength of plate in pounds.

= Efficiency of longitudinal joint. See sections 34 to 39).

= The inside diameter of the outside course of the shell or drum expressed in inches

= Lowest factor of safety allowed by these regulations.

28.—Efficiency of Ligament.

When a shell or drum is drilled for tube holes in line parallel to the axis of the shell or drum, efficiency of the ligaments between the tube es shall be determined as follows:

When the pitch of tube holes on every row is al the formula is:

$$\frac{P_1 - d_r}{P_1} = \text{Efficiency of ligament.}$$

P_1 = Pitch of tube holes in inches.

d_r = Diameter of tube holes in inches.

If the efficiency of the ligament as calculated the above rule is less than the efficiency of the gitudinal riveted joint it shall be substituted K in calculating the maximum working pres- re by the formula given in section 27.

29.—Factors of Safety.

Boilers well designed, well constructed and ade of good material should be allowed a higher orking pressure than boilers inferior in any of e above respects, and unless this is done the perior boiler is placed at a disadvantage, and od workmanship and the use of good material ll be discouraged.

To provide for the above, the following rules garding factors of safety for cylindrical boilers d cylindrical parts of boilers have been adopted.

When cylindrical shells of boilers are made
the best material (either iron or steel), with
holes drilled in place, from the solid plate,
plates afterwards taken apart and the burrs
moved, and all longitudinal seams fitted w
double butt straps, each at least five-eights
thickness of the plates they cover, the seams be
double riveted with rivets having an allowance
not more than 75 per cent. over the single she
and having the circumferential seams construct
so that the percentage is at least one-half that
the longitudinal seams, and provided that
boiler has been inspected by inspectors authori
by the Act during the whole period of constructi
in accordance with these regulations, then 4
may be used as a factor of safety. But when
above conditions have not been complied with,
additions in the following scale must be added
the factor of safety, according to the circumstan
of each case.

To be added to factor of 4.50:

A. .10 Holes in longitudinal seams, fair a
good, but drilled from solid out
place after bending edges of plates

B. .20 Holes in longitudinal seams, fair a
good, drilled from solid out of pl
before bending edges of plates.

C .20 Holes in longitudinal seams, fair a
good, punched, after bending edges
plates and reamed after assemblin

D .30 Holes in longitudinal seams, fair a
good, punched before bending ed
of plates and reamed after asse
ling.

E .07 Holes in circumferential seams, fair a
good, drilled from solid out of pl
after rolling plates.

.10 Holes in circumferential seams, fair and good, drilled from solid out of place before rolling plates.

.10 Holes in circumferential seams, fair and good, punched after rolling plates and reamed after assembling.

.15 Holes in circumferential seams, fair and good, punched before rolling plates and reamed after assembling.

.70 In longitudinal seams, if double butt straps are not fitted, and the said seams are lap and double riveted.

.50 In longitudinal seams, if double butt straps are not fitted, and the said seams are lap and treble riveted.

.60 In longitudinal seams, if only single butt straps are fitted, and the said seams are double riveted.

1.00 In longitudinal seams, when any description of joint is only single riveted or when double butt straps are used and only one row of rivets is in double shear.

.50 Holes or rivets in longitudinal seams, not fair or not good.

.20 Holes or rivets in circumferential seams, not fair or not good.

.40 Holes in any seams not properly spaced in crossing.

.40 When material is doubtful and not properly certified in accordance with regulations.

.50 If joints are not close fitting, the plates being open when boiler is finished or workmanship unsatisfactory.

R .50 If boiler has not been inspected by spectors authorized by the Act dur the whole period of construction in cordance with these regulations.

Where marked * the inspector may according circumstances increase the factor given, and the event of satisfactory information not be obtainable the inspector shall use a basic fac of safety of five (5) with such additions as judgment may dictate.

In the foregoing A, B, C, D, E, F, G, H must used separately, but may be added, when justifi to either I, J, K, L, M or N separately, and to P, Q or R separately, or to the whole four lat when calculating the efficiency of a joint.

S Where any boiler has been subjected overheating, strained by forci crystallised by age or otherwise paired, the factor of safety shall increased according to the discreti of the inspector.

Nothing in these regulations shall be constru as requiring the department to provide for t inspection of boilers outside of the province.

30.—Maximum Pitches for Riveted Joints.

$P_M = (C \times T) + 1\frac{5}{8}$.

When

T=Thickness of plate in inches.

P_M = Maximum pitch of rivets in inches (not to exce ten inches) immediately inside the caulki edge or edges.

C=Constant applicable from the following tabl

Numbe in or
1
2
3
4
5

Whe adopte ome c st pit itch s st pla

The ole to diamet

The joints no cas in join

Th ordina the siz

Number of rivets in one pitch.	Constant for lap joints.	Constant for double butt strap joints.
1	1.31	1.75
2	2.62	3.50
3	3.47	4.63
4	4.14	5.52
5	——	6.00

When work is first class such pitches may be adopted, so far as safety is concerned, yet, in some cases, it may not be well to adopt the greatest pitch found by the formula. The maximum pitch should not exceed ten inches with the thickest plates for boiler shells.

31.—Lap Outside Rivets.

The lap outside rivets measured from the rivet hole to edge of plate must be at least equal to diameter of rivet hole.

32.—Minimum Diameter of Rivet.

The minimum diameter of rivets in riveted joints shall be ⅝ of an inch after driving and in no case less than the thickness of any one plate in joint.

33.—Rivet Heads.

The button head or partly spherical form of ordinary rivet heads is recommended made to the sizes given below:

Size	Button Heads		Countersunk	
Diameter of rivet before driving	Height	Diameter at Base	Depth	Diameter at outside of sheet
5/8″	15/32″	1 1/8″	5/16″	1″
3/4″	9/16″	1 5/16″	3/8″	1 3/16″
7/8″	21/32″	1 1/2″	7/16″	1 3/8″
1″	3/4″	1 3/4	1/2″	1 9/16″

Providing conical head rivets are used the following proportions should be followed: the l of the head at eacn side of shank should be abo ¼ inch for ¾ inch rivets, 5-16 inch for ⅞ in rivets, and ⅜ inch for 1 inch rivets.

The height should not be less than three-qua ters of the diameter of the rivet.

34.—Efficiency of Riveted Joints.

The efficiency that a unit of length of a rivet joint has to the same unit of length of the sol plate of which that joint is composed shall calculated by the following formulæ:

In the following formulæ the strength of rive in double shear is taken as being 1.75 times the strength in single shear.

$$C = \text{a constant} = \frac{\text{Shearing strength of rivets per sq. in.}}{\text{Tensile strength of plate per sq. in.}}$$

and may be taken as:

.85 for iron rivets in iron plates.
.70 for steel rivets in steel plates.
.65 for iron rivets in steel plates.

Chain riveted joints are prohibited for use under these regulations which allow for use in boilers only the staggered types of riveting and limit the number of rows of effective rivets in joints to three whether in lap or butt strap construction.

K = efficiency of joint.

K_t = efficiency of plate in joint.

K_s = efficiency of rivets in joint.

K_{st} = efficiency of combined plate and rivets in joint.

K = K_t, K_s or K_{st}, whichever is least.

P = Pitch of rivets in inches in outside row when calculating the efficiency of joints.

d = Diameters of rivets after driving, equal diameter of rivet holes in joint.

T = Thickness of plate in inches.

35.—Single Riveted Lap Joint.

$$K_t = \frac{P-d}{P}$$

$$K_s = \frac{a}{P \times T} \times C$$

a = area of one rivet in single shear.

36.—Double Riveted Lap Joint.

$$K_t = \frac{P-d}{P}$$

$$K_s = \frac{2a}{P \times T} \times C$$

$2a$ = area of two rivets in single shear.

37.—Treble Riveted Lap Joint.

$$K_t = \frac{P - d}{P}$$

$$K_s = \frac{3a}{P \times T} \times C$$

3a = area of three rivets in single shear.

Single, double or treble riveted butt strap joints with single butt straps shall be considered equal respectively to single, double or treble riveted lap joints.

38.—Double Riveted Butt Joints with Equal Straps and Equal Pitch of Rivets in Each Row.

$$K_t = \frac{P-d}{P}$$

$$K_s = \frac{3.5a}{P \times T} \times C$$

3.5a = area of two rivets in double shear.

39.—Treble Riveted Butt Joints With Unequal Straps and Each Alternate Rivet Omitted in Outer Row.

$$K_t = \frac{P-d}{P}$$

$$K_s = \frac{8a}{P \times T} \times C$$

8a = area of four rivets in double shear plus one rivet in single shear.

$$K_{st} = \frac{(a \times C) + [(P-2d) \times T]}{P \times T}$$

a = area of one rivet in outer row in single shear.

40.—Distance Between Rows of Rivets.

$$V = \sqrt{\frac{(11P + 4d)(P + 4d)}{10}} =$$

Minimum distance in inches between rows of rivets for lap joints and double riveted butt joints with straps of equal width, when every other rivet is omitted in the outer row, and treble riveted butt joints with straps of equal width and with full number of rivets in all rows.

$$V = \sqrt{\left(\frac{11}{20}P + d\right)\left(\frac{1}{20}P + d\right)} =$$

Minimum distance in inches between rows of rivets in double riveted butt joints, with equal straps and with full number of rivets in all rows and between outer and middle rows of rivets for treble riveted butt joints when every other rivet is omitted in the outer row.

$V'_1 = \frac{\sqrt{(11P + 8d)(P + 8d)}}{20} =$ Minimum distances in inches for treble riveted butt joints between inner and middle rows when every other rivet is omitted in outer row.

$P_D = \frac{3P + 4d}{10} =$ Minimum diagonal pitch in inches for treble riveted butt joints between inner and middle row when every other rivet is omitted in outer row.

$P_D = \frac{6P + 4d}{10} =$ Minimum diagonal pitch in inches for all rows in double and treble riveted lap joints, also for double and treble riveted butt joints, with full number of rivets in all rows.

$P_D = \frac{3}{10} P + d =$ Minimum diagonal pitch in inches between outer and middle rows of treble riveted butt joints when every other rivet is omitted in outer row.

41.—Butt Straps With Full Number Rivets in all Rows.

T_1 = Thickness in inches for butt straps.

T_1 for double butt straps $= \frac{5 \times T}{8}$

T_1 for single butt straps $= \frac{9 \times T}{8}$

42.—Double Butt Straps for Joints with Unequal Straps when every Alternate Rivet is Omitted in Outer Row.

$$T_1 = \frac{5 \times T \times (P-d)}{8 \times (P-2d)}$$

43.—Longitudinal Seams.

All longitudinal seams of horizontal cylindrical shells of boilers shall be above the centre line of boiler. No longitudinal seam of any boiler shall have a continuous length of more than 10 feet. The difference in location of adjoining longitudinal seams (where more than one) on the cross section of boiler shall, where practicable, be not less than 30 degrees.

44.—Cylindrical Heads, Either Dished or Flat.

Convex heads when dished to a radius equal the diameter of the shell or drum to which they are attached, or less, and when they are also true portions of spheres do not require staying if their thickness is 1-16 of an inch more than the shell or drum plates as found by the formula in section 27.

The pressure allowable on heads which are dished to a radius greater than the diameter of shell to which they are attached is as follows: Being limited to that allowable for the shell to which they are attached and stayed as flat surfaces when thickness of head does not make "B" to equal that allowed for shell; but the resistance to rupture or collapse as found by the following formula may be considered when calculating the stays required.

$$B = \frac{(t-1) \times S_t}{R \times 56}$$

B = pressure allowable in pounds per square inch..
t = thickness of plate in sixteenths of an inch.
S_t = tensile strength of plate per square inch.
R = radius to which head is bumped in inches.
h = camber or height of bump measured from chord in inches.
c = diameter of spherical portion of head exclusive of of radius at flange in inches.

45.—Radius to which Head is Bumped.

$$R = \frac{(\frac{1}{2}c)^2 + h^2}{2h}$$

will give radius to which a head is bumped, care being taken to measure h and c correctly.

46.—Concave Heads.

Concave heads are to be considered as only 60 per cent. of the strength of convex after calculating as above. The circumferential joints for all such heads should be carefully calculated, being at least 55 per cent. the value of the solid plate, and double riveting used where practicable.

Flat heads should be stayed preferably by longitudinal stays having substantial upset ends and fitted with nuts and washers, the area to be stayed to be determined as follows: When the head is flanged and riveted to the shell, a portion of it becomes stiff enough to carry the boiler pressure without depending upon the braces. The distance that thus becomes self-supporting may be determined by the following formula:

The allowance in inches for shell as stay to head to equal

$\frac{1}{2}\sqrt{\frac{112 \times t^2}{B}}$ or radius of curvature of head flange whichever is greatest.

t = thickness of head in sixteenths of an inch.
B = working pressure.

48.—Area of Head to be Stayed.

When the area of any segment of a head to be stayed is required, one of the following formulæ shall be used:

$$A = \frac{h^2}{2c} + \frac{2c \times h}{3} \text{ or } \frac{4h^2}{3}\sqrt{\frac{2R}{h} - .608}$$

h = height in inches of segment to be supported.
c = length in inches of chord of segment to be supported.
A = area of the segment in square inches.
R = radius of inches in segment to be supported.

49.—Pitch of Stays in Head.

The pitch of stays is governed by the manner in which they are attached to the head. When riveted to the head, the area of rivets attaching them must be 20 per cent. in excess of the area of stays required.

N = number of stays required.
A = area of head requiring staying in square inches.
B = working pressure.
$A \times B$ = total stress on stay.

$$\frac{A \times B}{N \times C} = \text{area of one direct stay.}$$

50.—Maximum Stress Allowed on Stays.

C = constant for maximum stress per square inch on stays.
= 9000 for steel stays of 1.5 square inches net sectional area or over.
= 8000 for steel stays if under 1.5 square inches in net sectional area.
= 7000 for iron stays not welded.
= 5000 for iron stays that have been welded.

51.—Diagonal Stays.

Diagonal (round or square) stays must be increased in area to an amount which shall be not less than the area that would be required for a a direct stay multiplied by $\frac{H}{L}$

When H equals the length of diagonal stays,

L equals the length of a line drawn at right angles from the surface to be supported to a point on this line at right angles to the end of the diagonal stay.

The angle which a diagonal stay makes with the shell shall not exceed 30 degrees and should be as much less as possible. The welding of crow-feet or plain ends on stays is prohibited.

52.—Rivet Area for Stays.

The rivet area attaching stays of all kinds to a head or shell shall aggregate 20 per cent. greater than the stay area. If, however, the ends are attached to angle or tee bars the bolt or pin being in double shear may have an area of 25 per cent. less than the stay, but no allowance is to be made for value of the bars as stays in this or any other case.

53.—Minimum Diameter of Rivets in Stays.

The minimum diameter of rivets attaching stays of all kinds shall be ¾ of an inch.

54.—Gusset Stays.

When gusset stays (which must be attached to plates between two angle irons) are used their area shall be 10 per cent. in excess of that required for diagonal stays, but as diagonal stays can be used in most cases where gusset stays can, they should be given the preference.

The working pressure allowed on gusset stays shall be calculated as follows:

$$\frac{S_{wt} \times W \times T}{E} \times \frac{L}{H} \times .9 = B.$$

Where

E = area in square inches of surface supported.

S_{wt} = working tensile stress in pounds per square inch.

W = width in inches of web of stay at narrowest part.

T = thickness of web in inches.

H = as for diagonal stays.

L = as for diagonal stays.

55.—Flat Surfaces.

The maximum stress allowable on flat plates supported by stays shall be determined by the following formula:

All stayed surface formed to a curve the radius of which is over 21 inches, excepting surfaces otherwise provided for, shall be deemed flat surfaces.

$$\text{Working pressure} = \frac{C \times t^2}{p^2}$$

Where

t = thickness of plates in sixteenths of an inc
where doubling plates are used, for
take .75 of the combined thickness of bo
plates.

p = pitch of stays in inches when equally spac
in both directions.

C = 112 for screw stays with riveted heads, plat
seven-sixteenths of an inch thick a
under.

C = 120 for screw stays with riveted heads, plat
over seven-sixteenths of an inch thick.

C = 120 for screw stays with nut outside she
plates seven-sixteenths of an inch thi
and under.

C = 125 for screw stays with nut outside she
plates over seven-sixteenths of an in
thick and under nine-sixteenths of
inch.

C = 135 for screw stays with nut outside she
plates nine-sixteenths of an inch thi
and over.

C = 175 for stays with double nuts having one n
on the inside and one nut on the outsi
of plate, without washers or doubli
plates.

C = 160 for stays fitted with washers or doubli
strips which have a thickness of at lea
the thickness of the plate, and a diamet
of at least .5 of the greatest pitch of t
stay, riveted to the outside of the plat
and stays having one nut inside of t
plate and one nut outside of the washe
or doubling strip. For t take 72 per ce
of the combined thickness of the pla
and washer or plate and doubling strip.

C = 200 for stays fitted with doubling strips whi
have a thickness equal to at least t
thickness of the plate reinforced, a

= 200

When t

aken i

l = t

w = d

n cas

$+ p_2)$

8

covering the full area braced (up to the curvature of the flange, if any), riveted to the inside of the plate, and stays having one nut outside and one inside of the plates. Doubling plates to be substantially riveted. For t take 72 per cent. of the combined thickness of the two plates.

$= 200$ for stays with plates stiffened with tees or angle bars having a thickness of at least the thickness of plate and depth of web at least one-fourth of the greatest pitch of these stays and substantially riveted to the plates, and stays having one nut inside bearing on washers fitted to the edges of the web, that are at right angles to the plate. For t take 72 per cent. of the combined thickness of web and plate.

56.—Unequal Pitch.

When the pitches of stays are unequal, $\frac{l^2 + w^2}{2}$ is to

aken instead of p^2.

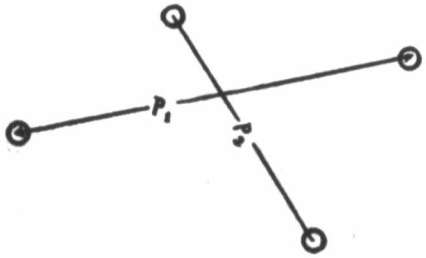
l = the pitch of stays in inches in one row.

w = distance in inches between two rows of stays.

57.—Irregular Staying.

n case of irregular staying as in figure below

$\frac{+ p_2)^2}{8}$ is to be taken instead of p^2.



58.—Tube Sheets.

The minimum thickness for a tube sheet of [illegible] size shall be 5-16 of an inch.

59.—Support Given by the Tubes.

The rectangular area covered by the tubes [illegible] tube sheets shall, in accordance with the follow[illegible] formula, be considered as stayed by the tubes, [illegible] no value is to be allowed for beading as stay[illegible] its use being only to protect ends of tubes f[illegible] fire or rust.

$$\frac{1}{2}\sqrt{\frac{112 \times t^2}{B}} - \frac{d_r}{2}$$

= distance in inches from edg[illegible] tube-hole to outside edge[illegible] rectangular area stayed by [illegible] tubes.

t = thickness in sixteenths of inch.

d_r = outside diameter of tubes.

B = working pressure.

60.—Minimum Size of Ligaments.

The minimum size of ligament between any [illegible] tubes shall be .3 square inches in section or [illegible] less than ¾ of a lineal inch measurement wh[illegible] ever is greatest, for boilers with horizontal tu[illegible] For vertical boilers the minimum size shall b[illegible] square inches in section or ½ of a lineal i[illegible] measurement which ever is greatest.

61.—Compressive Stress on Tube Sheet.

A greater compressive stress should not be [illegible] lowed on the upper edges of tubesheets w[illegible] crownsheets are supported by girders, and

ds of such girders rest on the upper edges of be sheets, the girders not being supported by g stays, than as found by the following for-ula, which limits such compressive stress to 00 pounds per square inch of sheet between

bes; $\frac{(D-d_{r1}) \times T \times 18000}{D \times W}$ = working pressure

= least horizontal distance between centres of tubes in inches.

= inside diameter of tubes in inches.

= thickness of tube plates in inches.

= distance in inches between tube sheet and opposite side of combustion or firebox.

The area of the tube sheet between the upper e of tubes and the bearing point of girder must sufficient to transmit, without distortion of the be plate, the stress above dealt with.

62.—Belly Stays.

In boilers 36 inches and upwards in diameter, the locomotive type with straight firebox tube-eets, the portion between bottom tubes and top y bolts in throat sheet must be stayed, as for surfaces, by belly stays riveted to the barrel, ir ends arranged to receive staybolt from tube-eet.

—Internally Fired Furnaces or Parts of Boilers (other than ordinary firetubes) subjected to compression.

The furnace plates in plain circular internally ed furnaces, not exceeding 42 inches in diam-r, if not found sufficiently strong must be

stayed as flat surfaces, allowing in the calculati
for such 75 per cent. of the value of the resista
to collapse as found by the following form
the pitch of stays being computed by the rule
flat surfaces, but the pitch shall in no case exc
eight inches on the furnace plate. For furna
over 42 inches in diameter no allowance for va
of resistance to collapse shall be made. C
must be taken not to reduce the efficiency of
riveted joint when applying these stays.

$$B = \frac{C \times T^2}{(L_1 + 1) D_r}$$

Where—

D_r = outside diameter of furnaces in inches.

T = thickness of plate in inches.

L_1 = length of furnace in feet, or length betw
rings.

B = working pressure per square inch, wh
must not exceed that found by the lin
ing formula, as follows:

$$\frac{10{,}000 \times T}{D_r} = B$$

C = constant according to the following circu
stances:

Furnaces with butt joints and rivet ho
punched small and reamed out in place.

112,500 where the longitudinal seams are dou
riveted, and fitted with single butt straps.

100,000 where the longitudinal seam is sin
riveted, and fitted with single butt strap.

112,500 where the longitudinal seam is sing
riveted and fitted with double butt straps,
where seam is welded.

Furnaces with lap joints and rivet holes punch
small and reamed out in place:

96,000 where the longitudinal seams are double veted.

87,500 where the longitudinal seams are single veted.

64.—Adamson Type Furnaces.

For furnaces of the Adamson type, which do not re-ire staying:

$$\frac{9{,}900 \times T}{3 \times D_r} \times \left(5 - \frac{l_1 + 12}{60 \times T}\right) = \text{working pressure.}$$

T = thickness of plate in inches.

D_r = outside diameter of body of furnace in inches.

l_1 = length between flanges in inches.

65.—Corrugated Furnaces.

$$\frac{000 \times T}{D_r} = B \text{ for steel furnaces.}$$

here—

T = thickness in inches.

D_r = Outside diameter in inches, measured at the ottom of the corrugations.

66.—Truncated Cones.

Flues used in vertical boilers as upper combus-n chambers formed in the shape of a frustrum a cone when new and made to true circles, all be allowed steam pressure according to the llowing formula:

$$= \frac{965.625t - 53.045l_1}{D_r}$$

= working pressure in pounds per square inch.

thickness of cone in sixteenths of an inch (not to be less than 5-16 of an inch).

D_r = outside mean diameter in inches.

l_1 = length of cone in inches which must not exce
(135 × thickness of cone plate in inches)—12.

When the mean diameter of a frustrum of
cone exceeds 36 inches the cone shall be deeme
a flat surface and must be stayed accordingly.

67.—Crown Sheets in Locomotive Type
Other Boilers.

When the tops of fireboxes or of combustio
boxes are flat (unless the outside sheet is parall
to the same) they may be supported by girde
properly fitted to the edges of the tube plate an
the back plate or to the side plates, as the ca
may be, by chipping and filing so that a goo
bearing may be effected on the edges of the
sheets and also upon the flanged curve of th
crown sheet. When the tops of fire-boxes or co
bustion boxes are curved they may be stayed b
radial or direct stays, which do not enter the she
at more than 5 degrees from a right angle to
tangent on sheet at point of contact, the pitch an
strength of the stays being determined by formul
The several rows of longitudinal stays on crow
sheets must make equal angles from vertic
centre line with the corresponding rows on opp
site side, and their pitch shall be determined b
the formula for flat surfaces. No stays shall b
permitted to pass between the tubes.

68.—Flat Crown Sheets on Traction an
Portable Boilers.

Perfectly flat crownsheets shall not be allowe
in traction and portable engine boilers, and th
camber of same as measured from the extensio

of side sheet to meet the curvature of centre of crown sheet shall not be less than the width of firebox × .14.

69.—Girder Stays on Crown Sheets.

The working pressure on girder stays supporting the top of fireboxes or combustion boxes shall be calculated by the following formula, the pitches of girder stays and bolts in same being determined by formula for staying flat surfaces:

$$\frac{C \times g^2 \times T}{(W-p) \times D \times L_1} = B$$

W = width in inches of combustion or firebox in line with girder.
p = pitch in supporting bolts in inches.
D = distance in inches between girders from centre to centre.
L_1 = Length of girder in feet.
g = depth of girder in inches at centre.
N = number of supporting bolts.
T = thickness of girder in inches.

$C = \frac{1200\ N}{N+1}$ when the number of bolts is odd.

$C = \frac{1200\ (N+1)}{N+2}$ when the number of bolts even.

If the girders are made of steel the value of C is to be increased 10 per cent.

70.—Water Space.

The water space outside the furnace of any internally fired boiler shall not be less than 2 inches in the clear. When the tops of fireboxes are supported by girders there shall be a clear waterway between the girders and crownsheet of not less than 1½ inches and preferably 1¾ inches.

71.—Wagon Tops.

Wagon tops or saddle sheets of boilers are pr
ferably made in one sheet with outside sheets
water legs. When radial stays from crownshee
enter the wagon top at any point at an angle le
than 65 degrees from a tangent to the wagon t
at point of contact the camber of crownshe
shall be increased to bring the angle within t
limit and ensure full threads of stay in wagon t

72.—Backheads of Locomotive Type Boilers.

The portion of backhead in a locomotive ty
boiler not stayed to firebox will be stayed und
the formula for flat surface.

73.—Throat Sheets.

Throat sheets in locomotive type boilers mu
not be thinner at any point than the sheets th
are attached to at the barrel connection. Th
must be double riveted at barrel connections.

74.—Hydrostatic Tests.

When hydrostatic tests are applied to boile
built according to these regulations they will
made in the ratio of 150 per cent. of the worki
pressure.

75.—Tensile Strength.

When the actual tensile strength of steel
wrought iron shell plates is not known, it sh
be taken at 55,000 pounds for steel and 45,0
pounds for wrought iron, provided sample of m
terial cut from boiler will pass prescribed bendi
test.

76.—When Special Formula is Necessary.

If it occurs that there are parts of any type of boiler for which formula has not been provided in these regulations, the case shall be submitted to the Department.

IV.—MATERIAL.

77.—Plate Maker's Name and Tensile Strength.

Every steel plate intended for the construction of boilers hereafter built for operation under these regulations must be stamped by the makers with their names and the tensile strength. The stamps must be so located that they are plainly visible after the boiler is constructed.

78.—Steel Plates.

Steel plates are to be homogenous, made by the open hearth process and having the following qualities:

79.—Qualities of Plates and Limits of Same.

Shell plates or plates on which flanging is to be done may have from 55,000 to 65,000 (maximum) pounds per square inch tensile strength, elastic limit not less than one-half the tensile strength, elongation not less than 22 per cent. in 8 inches, cold and quench bends 180 degrees flat on itself without fracture on outside of bent portion. Maximum phosphorus .04 per cent., maximum sulphur .04 per cent.

80.—Firebox Steel.

Firebox plates shall have from 52,000 to 62,000 (maximum) pounds per square inch tensile

strength, elastic limit not less than one-half th ultimate strength, elongation not less than 26 pe cent. in 8 inches, cold and quench bends 180 de grees flat on itself without fracture on outside o bent portion. Maximum phosphorus .035 per cent maximum sulphur .035 per cent.

81.—Rivet Steel.

Steel for boiler rivets shall have from 45,00 to 55,000 pounds per square inch tensile strength elastic limit not less than one-half the tensil strength, elongation not less than 28 per cent. i 8 inches, cold and quench bends 180 degrees fla on itself without fracture on outside of bent por tion. Maximum phosphorus .04 per cent., maxi mum sulphur .04 per cent.

It must test hot and cold by driving down on a anvil, the rivet being held in a tool; the head mus flatten until its diameter is 2½ times the diamete of the shank (hot test), and 1½ times the diam eter of the shank for cold test; all without de veloping cracks or flaws.

82.—Wrought Iron Plates and Bars.

Wrought iron, where used, must stand the sam bending tests as steel when bent lengthwise o plates or bars, but the tensile strength will be 2 per cent. less, also the elongation.

The elastic limit will be ½ the tensile strength

83.—Braces, Stays and Stay Bolts.

All braces, stays, and stay bolts are to be mad of iron or mild steel specially manufactured fo the purpose. Iron shall have a tensile strengt not less than 46,000 pounds per square inch, elasti limit not less than 26,000 pounds, elongation no less than 22 per cent. in a length of 8 inches

Steel to have a tensile strength of not more than 62,000 pounds and not less than 52,000 pounds, elastic limit not more than 33,000 or less than 26,000 pounds per square inch, elongation not less than 25 per cent. in 8 inches.

84.—Stay Bolt Bending Test.

Material for stay bolts must be smoothly rolled and free from slivers, depressions, seams, crop ends and evidences of being burnt.

Iron for stay bolts must stand the following tests: Double bending test; close in both directions without a flaw; nick and break test; a bar nicked all around to a depth of not less than 8 per cent., and not more than 16 per cent. of the diameter of the bar, and broken, shall show a clear fibre entirely free from crystallisation.

Steel for stay bolts must stand the following bending test: a bar taken at random full threaded must bend cold 180 degrees around a bar of its own diameter without showing any cracks or flaws. The use of the Whitworth type of thread is recommended for stay bolts.

85.—Tubes.

Tubes, of whatever material manufactured, must be truly cylindrical in form and meet the following physical tests:

For iron and steel the percentage of elongation must be not less than 22 per cent. in 8 inches the tensile strength, elastic limit, etc., must agree with that given for rivet bars.

Any tube must when cold stand without cracking, expanding on a mandril by repeated blows with a hand hammer until it is ⅛ larger than its original diameter.

A piece cut from the tube must flatten closely without cracking, and a piece cut lengthwise from a tube and flattened, must bend back on itself both cold and after being heated to a red heat and quenched, without cracking.

86.—Malleable Iron Castings.

Malleable iron castings, where used, must be clean and free from cracks. Samples from material intended for use in boilers constructed under these regulations must stand repeated blows when cold from a hammer without fracture.

87.—Rejection of Material.

In cases where tests show that for stay bars, rivet bars, tubes or malleable iron castings, three pieces (or in cases of lots of 100 or more, 3 per cent.) of those subjected to test fail to meet the foregoing requirements, the whole lot so submitted may be rejected.

88.—Cast Iron.

It is desirable that the use of cast iron in boiler construction under the provison of these regulations be discontinued.

It may be used for manhole plates, handhole plates, and nozzles for pressures not exceeding 100 pounds, but its use for manhole rings, steam domes or like purposes, is prohibited.

It must be clean and of a soft gray texture.

89.—Steel Castings.

May be made by the open hearth or basic process, but must receive such heat treatment as will produce a fine grained, homogenous and tough

metal, free from slag, cracks and cavities, injurious blow-holes and surface or other defects.
Tensile strength per square inch not below 60,000 pounds.
Elongation in two inches not below 23 per cent.
Reduction in area not below 30 per cent.
Phosphorous not over .06 per cent.
Sulphur not over .06 per cent.

V. WORKMANSHIP.

90.—Good Workmanship Essential.

The manner in which punching, swaging, cutting and caulking or beading tools, whether hand or machine used, are maintained, also the character of the workmanship generally, will be taken into consideration when determining the factors of safety. No leaks will be permitted to continue.

91.—Plates.

The edges of all plates must be neatly planed, sheared, rolled, bent or chipped without damaging them in any way.
All plates requiring scarfing must be properly done.

92.—Caulking.

Caulking is to be done by hand or pneumatic hammers and round-nosed tools; caulking edges are to be carefully prepared, the edges being bevelled sufficiently to hold the caulking. The fit of the joint must be made in laying of the plates, and excessive caulking avoided, and the lower plate not nicked or damaged by caulking tools.

93.—Butt Straps.

Butt straps must be pressed to correct shap and edges of sheets forming joints bent afte marking (but before holes are made) to ensur good fitting when assembled and correctness o form. The edges of butt straps must be plane and the joint at connection be protected. Th scarfing of butt straps must take in the circum ferential rivets.

94.—Holes in Sheets.

The drilling of rivet and stay bolt holes fro solid after plates are fitted is preferred, but the may, if not less in diameter than the thickness o the plate, be punched small before rolling afte the edges of the plates are bent, and drilled i line after assembling. If holes are punched the must, for rivet holes up to 13-16 of an inch i diameter, be punched ⅛ inch less, and for rive holes over 13-16 of an inch in diameter be punche 3-16 inch less and reamed after assembling to en sure exact size and good, fair holes (all materia damaged by punching being entirely removed).

All burrs must be removed, the plates bein separated for this purpose.

95.—Scarfing.

All plates requiring scarfing must be properl prepared in order to allow the joint to be wel fitted and set up.

The lap over rivets on edge of scarfed portio must be at least equal to the diameter of the rivet

Joints must be examined while assembling be fore any riveting is done. When assembled, joint must be close and well-fitting, being brought to

gether by fitting up bolts in holes specially prepared. The bringing of plates together by rivets is forbidden. Holes in flanged plates must not be punched or drilled on inner plates until plates are assembled when holes are to be marked off from outer plates, the holes then made and reamed after again assembling.

96.—Holes to be Fair.

After reaming, all holes for rivet seams must be fair, punch marks obliterated by it, and so formed that rivet heads will lie fairly to the sheet and be concentric with the rivets.

Holes for stays and stay bolts must be left small for reaming to ensure the threads in both sheets being full and in a straight line.

97.—Drift Pins.

Drift pins may be used with light hammers to pull the plates into position, but they must not be driven with such force as to disturb the metal about the hole.

98.—Templets.

The use of permanent steel templets for standard work is recommended. For other work it is considered good practice to prepare one set of plates from which while flat a second set is marked off and assembled, the first set if correct being used as templets for the rest.

99.—Rivets.

Rivets should be driven wherever possible by power riveters; air hammers may be used where practicable. Rivets must be heated their whole

length, and be of such length as to fill the holes by upsetting and form full heads, being left to cool under pressure of rivetter until black.

100.—Flanging Sheets.

Flanging or forming should be done at one heat, where two or more heats occur the whole plate should be heated at the conclusion of the flanging and left to cool slowly and equally, being covered and unexposed to draughts of cold air, the same treatment being given plates flanged in one heat, in which case reheating is not necessary. Sharp corners in flanges must not occur; the minimum inside radius allowed in flanges is one inch.

101.—Tubes.

Tubes must fit the holes in tube sheets as nearly as possible before expanding, the end nearest fire being a driving fit when applied. The ends must be prepared for this, and the holes in sheets be truly round, with edges slightly rounded and true to size.

The hole in sheet where the tube is entered is to be only large enough to allow free entry of tube.

Tubes must be expanded by roller expanders.

The ends of tubes must not extend more than three-sixteenths to one-quarter inch beyond sheet, according to the thickness of tubes, and then be beaded against the tube sheet without cracking, to ensure which the ends of tubes must be annealed.

The hand welding of tubes is prohibited.

102.—Tube Sheets.

All tube holes must be truly round. The holes may be punched three-sixteenths of their diameter small and bored to size with a rose cutter. The edges of holes are to be slightly rounded to prevent damage to tubes.

103.—Stays.

All screwed stays must have full, clean threads, true to size, and where riveted they must be neatly and carefully finished, the centre of stay in no case standing more than two and one-half or less than two threads above the sheets and be free from cracks after riveting.

Where stay nuts are used they must have true and smooth bearing on the sheets or washers when brought up, all threads being true to shape and size.

VI. FITTINGS.

104.—Quality and Strength.

The material of all mountings and fittings must be of good quality and sufficient strength to withstand strains from internal pressure and work for their respective uses; those attached to boilers carrying over one hundred and twenty-five pounds of steam shall be of the class known as extra heavy.

The nipples attaching same, when over one inch in nominal diameter and screwed connections are permitted, must be made of pipe, the walls of which are at least fifty per cent. thicker than ordinary standard steam pipe.

105.—Mode of Attaching.

Fittings or their bases when riveted to a boil
must be carefully fitted to the boiler before rive
ing, and in case of cast iron a caulking strip
soft steel or iron inserted between the boiler an
cast iron. The thickness of the flange of any iro
casting riveted to a boiler must not be less tha
three times the thickness of the sheet to whic
it is riveted.

Fittings must be provided for every boiler a
follows:

106.—Safety Valves.

Every boiler shall be provided with a lock po
safety valve of approved design under the follow
ing conditions:

The springs and valves are to be cased in, s
that they cannot be easily tampered with.

Provision is to be made to prevent the valve
flying off in case of springs breaking.

Lifting gear is to be provided to ease all valves

The springs must have a sufficient number o
coils to allow a compression under the workin
load of one-eighth the diameter of the valve.

Each valve is to be provided with a cap fo
safely protecting its adjustable parts, and fitte
in such a manner that it can be efficiently seale
by the inspector.

With valves over two inches in diameter flang
connections must be used.

107—Area of Valve.

The area of any safety valve, measured at th
inside point of contact between the valve and th

seat, shall be proportional to the size of the fire grate according to the following formula:

$$A = \frac{37.5 \times G}{B+15}$$

Where—

A=area of valve in square inches at point of contact between valve and seat.

G=area of fire grate in square feet.

B=working pressure in pounds per square inch.

108.—Testing Valves.

When considered necessary, the safety valves shall be tested under full steam and full fires for at least fifteen minutes with feed water shut off and stop valve closed; if the accumulation of pressure exceeds 10 per cent. of the working pressure of the boiler, a larger safety valve must be substituted.

109.—Twin Valves.

All boilers requiring safety valves to be over inches in diameter are to be equipped with twin valves instead of one large valve. Where the twin valves, or more than one valve are used, the minimum combined cross sectional area shall be in accordance with the formula in section 107.

110.—No Cast Iron Seat Allowed.

Safety valves having either the seat or disc of cast iron shall not be allowed.

111.—Maximum and Minimum Diameter of Valve.

The diameter of a safety valve used on a boiler shall not be less than 1 inch or more than 3 inches.

112.—Location of Valve, Escape Pipe, etc.

All safety valves are to be fitted independently of any other connection to the boiler, and must be placed immediately at the boiler, and no valve of any description shall be placed between the safety valve and the boiler, nor on the escape pipe between the safety valve and the atmosphere; the escape pipe shall have an open-ended drain at its lowest point. The safety valve shall be located so as to be accessible and must not be connected to an internal pipe in the boiler.

113.—Fusible Plug.

Every boiler shall be equipped with at least one fusible plug, which shall be kept in clean and efficient condition. The body of the plug shall be composed of brass with a taper hole through its centre, the smallest diameter of this hole to be at least ⅜ of an inch and to be filled with good banca tin to efficiently protect the fire line when the water falls below the minimum level prescribed by these regulations, and shall project through the sheet not less than ¾ of an inch and be located as shown and approved in design. All fusible plugs must be renewed at least once each year and examined at each washout.

114.—Steam Gauge.

Every boiler shall be provided with a correct pressure gauge of proved reliable make, which shall be tested by the inspector at the time of inspection, and must be set to correspond with a standard test gauge and placed so as to be plainly visible by the operator. Traction and portable boilers shall be provided with a steam gauge having double tube type.

115.—Dial of Gauge.

The dial of the steam gauge shall be graduated to not less than 1½ times the maximum pressure carried on the boiler, and for dark hours shall be well lighted.

116.—Syphon and Cut-out Cock.

All steam gauges shall be connected directly to the boiler and shall be fitted with a syphon or equivalent device sufficiently large, to fill the gauge tube with water, a cut-out cock with T or lever handle to be placed between the syphon and the boiler, to which it is to be directly coupled unconnected with any other fitting.

117.—Inspector's Test Gauge Connection.

A ¼ inch size pipe connection must be provided on every boiler to permit inspector's gauge to be connected above the cock on syphon pipe, for the purpose of testing in service the working steam gauge on boiler.

118.—Gauge Glass.

Every boiler shall have at least one water glass not less than 6 inches in length (as meas-

ured between the gland nuts), the visible bottom end of which shall be at least 2 inches above the fireline which in vertical unsubmerged tubesheet, firetube boilers shall be ⅔ the height of tubes, and for other boilers the highest point of crown-sheet or firetube.

All water gauges must be capable of being operated from floor of boiler room or working platform of a traction engine or portable boiler, and in dark hours must be well lighted.

119.—Gauge Cocks.

Every boiler shall have two (and in boilers exceeding 30 inches in diameter) three gauge cocks, with ¾ inch pipe thread connections to boiler and minimum bore of ⅜ of an inch located within the range of gauge glass, the lower cock to be placed in the same plane as the bottom of the glass and the others at least 2 inches apart, measured vertically. In traction or portable boiler the gauge cocks must be inserted within reach of operator in the face plate or in a water column attached to same. The cock must be so made that the passages can be cleaned out without removing cock from boiler. In stationary boilers, where gauge cocks cannot be conveniently operated a second gauge glass may be used instead of gauge cocks, provided the second gauge glass is separately connected to the boiler.

120.—Water Column and Connections.

The internal diameter of any water column and pipes attaching the same to the boiler shall be as follows:

Diameter of Boiler.	Least Internal Diam. of Pipe.	Least Internal Diam. of Col.
Up to and including 36 in.	1 in.	2 in.
Above 36 in. to 54 in..	1¼ in.	3 in.
Above 54 in.	1½ in.	3 in.

Straightway stop valves or cocks of correct size are to be fitted at the top and bottom of the column. The fittings at the connections to the boiler shall be as short as possible, and conveniently arranged with tees or crosses, having brass plugs for cleaning out. The waste pipe and valve at the bottom of the column shall be at least ½ the diameter of conecting pipes from boiler to column, and the end of the waste pipe plainly visible, so that the discharge may be noted.

121.—Feed Water Supply.

Each boiler of 15 horsepower in capacity or over shall be equipped with two separate means capable of supplying feed water, while the maximum steam pressure is carried on the boiler. Direct pressure to the boiler from a waterworks shall not be considered as one of the two means. A sufficient reserve supply of water for feeding boiler must, in all cases, be provided for use with injectors or pumps.

122.—Feed Arrangements.

Each boiler shall have a feed pipe fitted with a check valve and also a stop valve between the check valve and the boiler. The feed water should be fed at the coolest part through an internal pipe where possible, but never near the parts of a boiler

that are exposed to the direct heat of the fire o
through the blow-off connection—mud pans a
water level at end of internal feed pipe are recom
mended, but they must not rest on the tubes.

123.—Stop Valves on Steam Mains.

Each steam outlet for a boiler (except safety
valve connections) must be fitted with a stop
valve immediately at the boiler, in addition to
the stop valve at engine. Any stop valve 3 inches
in diameter or over used on a steam main carry-
ing a pressure exceeding 80 pounds per square
inch shall be equipped with the outside screw and
yoke type gate valve.

The use of angle valves at the end of a long
steam main is not permissible.

124.—High Pressure Fittings.

All high pressure boilers, that is boilers carrying
or intended to carry a pressure exceeding 125
pounds per square inch, must be equipped with
heavy fittings.

125.—Steam Mains.

Provision shall be made for the expansion and
contraction of steam mains connected to all boil-
ers, by substantial anchorage at suitable points,
to prevent perceptible vibration on the boiler
shell plates.

126.—Drains.

All steam mains shall be efficiently drained.
Where traps are connected to high pressure drains
the discharge end of trap shall be open for ob-

servation at all times. All drain cocks and valves must be accessible, and so placed as to render it practicable to drain any portion of the steam pipes or chests in connection therewith.

127.—Blow Off Pipes and Valves.

Each boiler must be provided with a substantial blow-off pipe and straightway valve or packed cock, the minimum diameter of which shall be 1 inch and the maximum 2½ inches. The pipe and valve or cock must be adequately protected from the products of combustion. Globe or angle valves shall not be used for this purpose. Each blow off pipe in a battery of boilers shall be connected independently to the drain, or open to the atmosphere.

The valve or cock is to be connected to the boiler at the lowest point; if above one inch in diameter, a reinforcing plate is to be riveted to the shell of the boiler, and the blow-off pipe or cock attached to it. For externally fired boilers, such as return flue and return tubular, the blow-off connection must be made to the bottom of the shell, and to the mud drum or header for water tube boilers at the back end.

An opening in brick work for the blow-off pipe shall be fitted with an ample cast or wrought iron sleeve, to provide for free expansion or contraction. A bottom blow-off cock shall be protected by a guard or gland. The end of a plug shall be distinctly marked in line with its passage.

128.—Side Lugs and Settings for Horizontal Cylindrical Boilers.

The following rule shall be observed in the setting of cylindrical externally fired boilers:

(*a*) No boiler shall be suspended from the crown or allowed to stand on a pedestal at the back end.

(*b*) All externally fired boilers up to and including 12 feet in length may be supported upon four cast-iron brackets resting upon substantial plates set in the brick work, and the back lugs resting upon rollers between the lugs and plate to provide for the expansion of the boiler.

(*c*) Boilers over twelve feet and under sixteen feet long shall be suspended at the back end from single side lugs placed on each side. The front end shall be supported by steel brackets resting upon a substantial plate let into the brick work. All such plates must be carefully levelled to fit the brackets.

(*d*) Boilers sixteen feet long and over shall be suspended at the front and back by side lugs set in pairs. All lugs in brackets shall be located at each side above the fire line and properly fitted to the curvature of the shell. The shearing stress on rivets attaching same must not exceed 8 per cent. of the shearing strength.

(*e*) All lugs must be of steel plate and, when set in pairs, so designed and located as to allow an equal stress on each lug.

(*f*) Suspension, when required by the preceding clauses, shall be from wrought iron or steel beams which shall be carried by and secured to iron or steel columns (preferably cast iron), having bases bolted to substantial foundations. (See figures 1 and 2.) Suspension beams or supporting columns shall not rest on the side walls of the brick setting.

129.—Back Arch.

Back arches shall be set in such a manner as to allow for the free expansion of the boiler, and placed clear of the fusible plug.

All flues and back settings shall be constructed with doors in the lower part of the setting not less than sixteen inches by sixteen inches, so arranged as to be easily accessible at all times.

Distances from back head of return tubular boilers to the back wall shall not be less than the following:

20 inches for boilers 30 inches to 42 inches diameter.

24 inches for boilers 44 inches to 60 inches diameter.

28 inches for boilers 60 inches to 72 inches diameter.

130.—Boiler Room Doors.

It is recommended that all exits from the boiler room should open outwards.

VII. INSPECTION.

131.—For the purpose of carrying out the provisions of the Steam Boiler Act as to inspection the following provisions shall apply.

132.—Every inspector shall keep a true record of all boilers inspected by him, and shall render annually a concise report to the minister of all inspections made by him during the preceding year.

133.—(1) No boiler which has been in use for two or more seasons shall be sold or exchanged for subsequent use as a boiler unless it is accompanied by an inspection certificate issued within one year next preceding the date of such sale or exchange.

(2) Nothing in subsection 1 shall affect any arrangement that may be made between a manufacturer and a purchaser in respect of an exchange of an old boiler in part payment for a new one and the subsequent sale of such rebuilt boiler or the retaking possession of a boiler under a lien and the subsequent sale thereof.

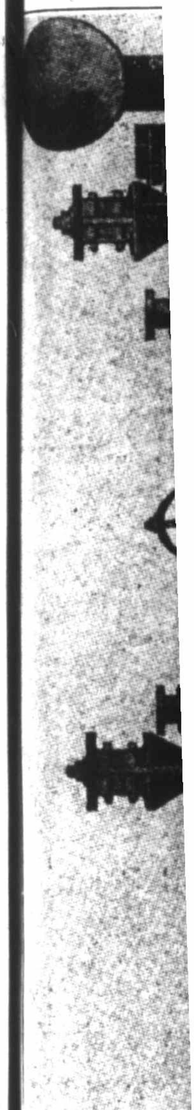
(3) Any person, company or agent who sells or exchanges a boiler shall within thirty days after such sale or exchange notify the minister in writing by registered mail of such sale or exchange stating the name and address of the person to whom such boiler has been sold or exchanged and shall in case such boiler has been inspected by an inspector from and after the first day of July, 1913, state the number stamped on such boiler at such inspection by the inspector.

134.—(1) An inspector may at all reasonable hours examine boilers in course of construction or undergoing repairs and refuse to grant a certificate of inspection for any boiler found to be improperly constructed or repaired or of which permission to make such inspection has been refused.

(2) In order to satisfy himself as to the thickness of the plate or its internal condition an inspector may cut holes or may order holes to be cut in the same and in the latter case the owner shall forthwith see that such orders are complied with.

135.—(1) The owner or operator of any steam boiler in which alterations or extensive repairs are being made shall allow the inspector free access to the same; and shall furnish water and fill the boiler to permit of the hydrostatic test being made and when necessary shall remove any jacket or covering from the boiler as directed by the inspector; he shall also assist the inspector

Fig. 1—Front Elevation and Partial Section of Suspended Boilers.



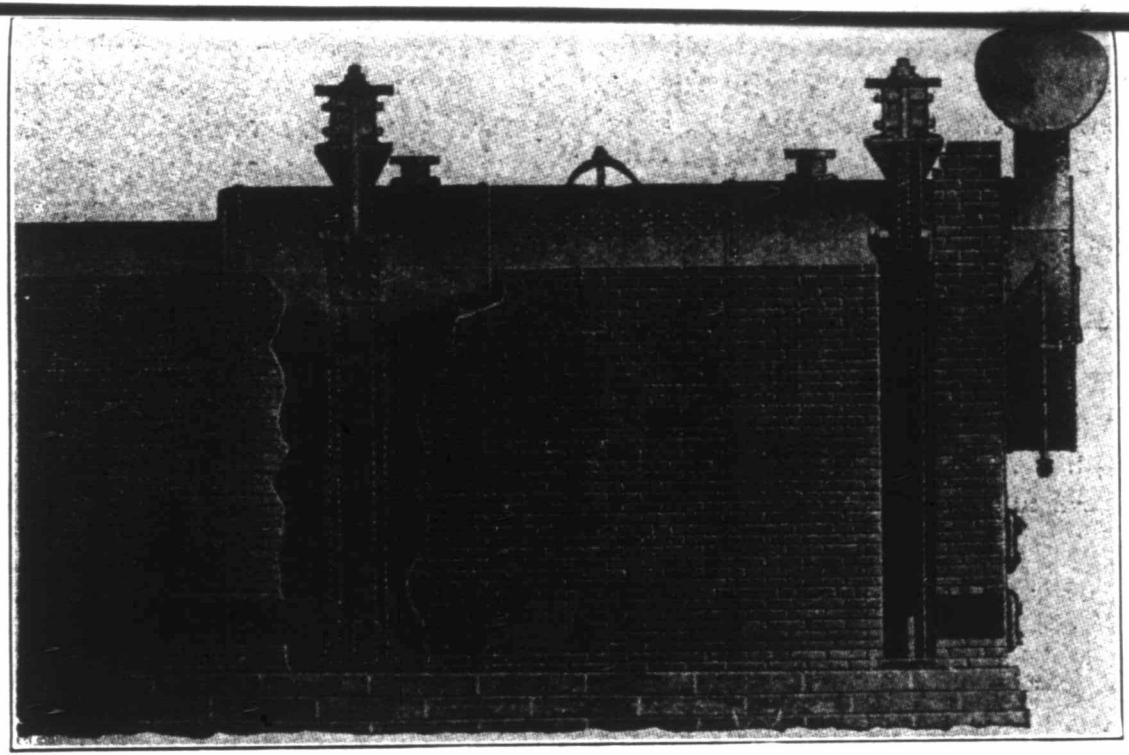


Fig. 2—Side View of Suspended Boilers.

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137.—E
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making his inspection and shall point out any fect that he may know of or believe to exist the boiler or the machinery connected therewith.

(2) Before a stationary boiler is subjected to e hydrostatic test the owner or operator shall e that it is opened for inspection, the manhole nd handhole plates removed, the flues cleaned nd all soot removed; and in the case of a portble boiler the owner or operator shall see that he furnace grates and straw burners are taken ut and the fire box thoroughly cleaned.

(3) Should any owner refuse or neglect to have he above provisions complied with the inspector nay have the work done at the expense of the wner.

136.—(1) Every new boiler sold or exchanged or use within the Province from and after the irst day of July, 1913, shall be constructed in accordance with specifications set forth in the foregoing regulations.

(2) For the purposes of rating boilers in accordance with the foregoing regulations the standard shall be: One horse power for each twelve feet of heating surface on all stationary and return tubular boilers or for each nine square feet of heating surface on all boilers of locomotive type.

137.—Every steam boiler shall be supplied with a fusible plug of good banca tin inserted in the flues or other portion of the boiler exposed to heat from the furnace when the water therein falls below the limit allowed by these regulations.

APPENDIX A.

Specifications.

Details to be shown on form submitted with each design as required under Section 7 of the foregoing Regulations.

Note.—Manufacturers are requested to use only the regular form supplied by the Department for the purpose of submitting these specifications.

Make of boiler .....
Rated horse power .....
Designed to carry.....pounds working pressure
To accompany drawings No.....
Record No.....(*To be filled in at Department*).

Shell.

Diameter .....
Length .....
Height .....
Thickness of plates .....
Thickness of cylindrical shell .....
Thickness of side sheets .....
Thickness of throat sheets .....
Thickness of back sheets .....
Style of longitudinal seam .....
Number and thickness of covering plates .....
Number of rows of rivets .....
Pitch of rivets .....
Size of rivet holes .....
Distance centre holes to edge of plate .....
Circumferential seam .....
Number of rows of rivets .....
Size of rivet holes .....
Pitch of rivets .....
Distance centre of holes to edge of plate .....
Thickness of heads .....
Number of side lugs and method of suspension...

Steam Dome or Drum.

Height or length .....
Diameter .....
Thickness of plate .....
Thickness of head .....
Radius in inches to which head is bumped .....
Style of longitudinal joint .....
Number of rows of rivets .....
Diameter and pitch of holes .....
Style of joint at flange .....
Diameter and pitch of holes.....
Method of staying head .....
Size and pitch of stays .....

Combustion Box or Firebox.

Length .....
Width .....
Height .....
Grate area in square feet .....
Thickness of crown sheets .....
Thickness of back sheet .....
Thickness of tube sheets .....
Thickness of side sheets .....
Greatest pitch of staybolts (horizontally) .....
Greatest pitch of staybolts (vertically .....
Diameter of staybolts at base of thread .....
State how crown sheet is stayed.....
Greatest pitch of radial stays .....
Diameter of radial stays at base of thread.....
Number of girders .....
Length of girders .....
Depth and thickness of girders .....
Number, diameter, and pitch of supporting bolts per girder .....
Riveted or nutted .....
Thickness of tube plates .....
Arrangement of tubes .....

Least horizontal distance between centre of tube
Inside diameter and thickness of tubes .....
Number and length of tubes .....
Outside diameter of main flue .....
Thickness of main flue .....
Style of joint of main flue .....
Pitch of rivets main flue.....
Size of rivet holes main flue .....

FURNACE IF CIRCULAR.

Type of furnace .....
Number of furnace .....
Outside Diameter .....
Outside diameter at bottom of corrugations .....
Thickness of plates .....
Length of furnace .....
Length between rings .....
Style of rings .....
Style longitudinal seam .....
Pitch and net diameter of stays in furnace .....
Distance between rows of stays .....

STAYING.

Height of segment above tubes .....
Total area of surface supported above tubes .....
Total area of surface supported below tubes .....
Number and smallest diameter of through stays ..
Pitch of through stays .....
Double or single nutted .....
Washers or doubling plates .....
Thickness and diameter of washers .....
Thickness of doubling plates .....
Pitch of rivets in doubling plates and washers..
Number and driven diameter of rivets, doubling plates, and washers .....
Greatest pitch of diagonal stays .....
Number and smallest diameter of diagonal stays..

Length
Number
Length
Thickne
Size of a
Number
stay
Number
stay
Pitch of
Maximu

Ordinary
Safety v
Diamete
and
Number
Where l
Nozzles,

Type an
Location

Internal
Size of p
Size of w
Size and
Blow off
Blow off
Steam g
Steam g

Length of stays and lines .....
Number of gusset stays .....
Length of gusset stays and of lines .....
Thickness of web, and depth of narrowest part....
Size of angle iron and stay pin .....
Number and driven size of rivets at head end of stays .....
Number and driven size of rivets at shell end of stays .....
Pitch of rivets in crow feet .....
Maximum area supported by one stay .....

Fittings.

Ordinary, or extra heavy .....
Safety valve, maker's name .....
Diameter of valve at point of contact between valve and seat .....
Number of valves .....
Where locate .....
Nozzles, steel, iron or malleable .....

Fusible Plug.

Type and size .....
Location of Plug .....

Water Gauge Fittings.

Internal diameter of water column .....
Size of pipe connections to boiler .....
Size of water gauge mountings .....
Size and number of try cocks .....
Blow off cock, type and size .....
Blow off cock, location of connection at boiler....
Steam gauge, maker's name and size .....
Steam gauge, single or double tube .....

MATERIALS TO BE USED IN CONSTRUCTION.

Shells.

Maker's name .....
Tensile strength .....
Elastic limit .....
Elongation in eight inches .....
Maximum sulphur .....
Maximum phosphorus .....

Heads.

Maker's name .....
Tensile strength .....
Elastic limit .....
Elongation in eight inches .....
Maximum sulphur .....
Maximum phosphorus .....

Furnace and Flues.

Maker's name .....
Tensile strength .....
Elastic limit .....
Elongation in eight inches .....
Maximum sulphur .....
Maximum phosphorus .....

Tubes.

Maker's name .....
Lap or butt weld .....
Solid drawn .....

Stays and Stay Bolts.

Tensile strength .....
Elastic limit .....
Elongation in eight inches .....
Bending test .....

Rivet Steel.

Tensile strength .....
Elastic limit .....
Elongation .....
Maximum sulphur .....
Maximum phosphorus .....
Bending test .....

WORKMANSHIP.

Method of Preparing Holes.

State whether holes were drilled from solid to size, or punched small and reamed to size, and if latter, give size of punched hole.

Rivet holes .....

Tube holes .....

Holes in circumferential seams, punched (or drilled) before or after bending .....

Holes in longitudinal seams, punched (or drilled) before or after rolling .....

Remarks *re* manufacture .....

Signature of firm .....

APPENDIX B.

AFFIDAVIT OF SHOP FOREMAN.

Required under Section 9 of the foregoing Regulations.

CANADA:

(Or country where oath is taken.)

Province .....

or State of .....

To wit:

I, ..., foreman in the boiler shops of the ..... of.....in the..... make oath and say:

(*a*) That boiler No.....manufactured in the above shops under my supervision, and shipped to .....at ..... has been built in all respects true to Drawings No.....and Specification No..... which have been approved by the Department of Public Works of the Province of Ontario.

(*b*) That steam gauge attached to this boiler has been tested by our Company with a standard test gauge and is correct.

(*c*) That safety valve has been tested on the boiler and is set to relieve the pressure at..... .....pounds per square inch.

(*d*) That a hydrostatic test of..... pounds per square inch has been applied, and the pressure maintained for at least thirty minutes

with water at a temperature of or about 60 degrees Fahrenheit, without developing any leak or rupture.

(*e*) That the construction has been done in the best manner of workmanship throughout, and that to the best of my knowledge and belief the boiler complies in all particulars with the provisions of The Steam Boilers Act and Regulations of the Province of Ontario.

Sworn before me at .....
in the Province (or State of).....
this.....day of.....19...

.....
Shop Foreman.

.....
A Commissioner, J.P. or N.P.

This boiler has been sold to .....
who lives at .....
and whose post office address is .....

.....
Sales Agent.