

Chapter Ind 41

BOILER AND UNFIRED PRESSURE VESSEL CODE

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History: Chapters Ind 41 and 42 as they existed on April 30, 1961 were repealed and new chapters Ind 41 and 42 are created effective May 1, 1961.

PART I

SCOPE

Ind 41.01 Scope. (1) The provisions of this code apply to boilers and unfired pressure vessels in use at places of employment and in public buildings.

Note. Section 101.01 (1), Wis. Stats., provides that the phrase "place of employment" means and includes every place, whether indoors or out or underground and the premises appurtenant thereto where either temporarily or permanently any industry, trade or business is carried on or where any process or operation directly or indirectly related to any industry, trade or business is carried on and where any person is directly or indirectly employed by another for direct or indirect gain or profit but shall not include any place where persons are employed in (a) private domestic service which does not involve the use of mechanical power or, (b) farming. The term "farming" includes those activities specified in section 102.04 (4) and also includes the transportation of farm products, supplies or equipment directly to the farm by the operator of said farm or his employees for use thereon if such activities are directly or indirectly for the purpose of producing commodities for market or as an accessory to such production.

(2) Vessels used for the storage and transportation of liquefied petroleum gas, anhydrous ammonia, and refrigerants shall be subject only to the provisions of this code found under Part V "New Installations", Part VII "Repairs, Additions, Alterations, and Special Rules", and Part VIII "Second Hand Boilers and Second Hand Unfired Pressure Vessels."

(3) The provisions of this code do not apply to air eliminators, scraper traps, and similar devices on the pumping and dispensing equipment or systems used in the transportation, storage, or distribution of flammable liquids.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

PART II

DEFINITIONS

Ind 41.02 Definitions. (1) A.S.M.E. BOILER AND UNFIRED PRESSURE VESSEL CODES are those published by the American Society of Mechanical Engineers.

(2) **BOILER.** A closed vessel intended for use in heating water or for the application of heat to generate steam or other vapor to be used externally to itself.

(a) *Low pressure boiler.* A boiler on which the safety valves are set at pressures not exceeding 15 psig.

(b) *Miniature boiler.* A boiler on which the safety valve is set at over 15 psig and that does not exceed the following limits:

- 16 inch inside diameter of shell;
- 42 inches overall length of outside to outside of heads at center;
- 20 square feet water heating surface;
- 100 psi maximum allowable working pressure.

(c) *Portable boiler.* An internally fired boiler primarily intended for temporary location and whose construction and usage is obviously of a portable nature.

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(d) *Power boiler.* A boiler on which the safety valves are set at a pressure of more than 15 psig and that exceeds the dimensions of a miniature boiler.

(3) **CERTIFICATE OF COMPETENCY.** A certificate issued to a boiler or pressure vessel inspector who has passed a prescribed industrial commission examination.

(4) **EXISTING INSTALLATION.** Boiler and unfired pressure vessels placed in operation or contracted for prior to January 1, 1957.

(5) **EXTERNAL INSPECTION.** One made while boiler or vessel is in operation.

(6) **FUSION WELDING.** The melting together of filler metal and base metal, or of base metal only, which results in coalescence.

(7) **HOT WATER HEATING BOILER AND HOT WATER SUPPLY BOILER.** A boiler completely filled with water that furnishes hot water to be used externally to itself at pressures not exceeding 160 psig and at temperatures not exceeding 250 F. (A boiler exceeding these limits shall be classified as a power boiler.)

(8) **INSPECTOR, AUTHORIZED OR QUALIFIED.** (a) *Field inspector.* A boiler or unfired pressure vessel inspector who holds a valid certificate of competency.

(b) *Shop inspector.* A boiler or unfired pressure vessel inspector who is employed by a city or state which has adopted the A.S.M.E. boiler and pressure vessel code, or who is employed by an insurance company, and who when performing shop inspections in Wisconsin holds a Wisconsin certificate of competency.

(9) **INTERNAL INSPECTION.** One made when the boiler or unfired pressure vessel is shut down and handholes and manholes or other inspection openings are opened or removed for inspection of the interior.

(10) **MAJOR REPAIR.** One upon which the strength of the boiler or vessel depends.

(11) **NEW INSTALLATION, BOILER OR UNFIRED PRESSURE VESSEL.** One placed in operation or contracted for after January 1, 1957.

(12) **NON-STANDARD BOILER OR NON-STANDARD UNFIRED PRESSURE VESSEL.** One not bearing a valid Wisconsin stamping, nor the A.S.M.E. stamping, nor the National Board stamping, nor the Interstate Commerce Commission stamping, nor the stamping of the A.P.I.-A.S.M.E., nor any stamping authorized by other applicable codes.

(13) **OWNER OR USER.** Any person, firm, or corporation owning or operating a boiler or unfired pressure vessel.

(14) **SECOND HAND VESSEL.** A boiler or unfired pressure vessel when both location and ownership have been changed subsequent to the original installation.

(15) **UNFIRED PRESSURE VESSEL.** A vessel that obtains its pressure from an external source or from an indirect application of heat.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

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PART III

GENERAL RULES

Ind 41.03 Safety regulations. (1) No boiler or unfired pressure vessel shall be operated at a pressure in excess of the allowable working pressure stated on its current inspection certificate.

(2) No unauthorized person shall remove or tamper with any connected safety device nor shall any person adjust a connected safety valve to a greater relieving pressure than that allowed for the vessel as stated on its current certificate of inspection.

(3) Boiler and unfired pressure vessels shall be so installed that there will be sufficient room between the vessel and any ceiling, wall, partition, or floor to facilitate the connection and operation of valves, pipes, and other appurtenances.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.04 Reporting of accidents and major repairs. (1) Whenever a boiler or unfired pressure vessel fails and causes injury to any person, the owner or user shall report the facts involved to the industrial commission within the following 24 hours. The owner or user shall not remove or disturb the vessel or any of its parts nor permit any such removal or disturbance prior to receiving authorization from the industrial commission, except for the purpose of saving human life or further property damage.

(2) The owner, user, or his agent shall report any major repairs of a boiler or unfired pressure vessel as provided in Part VII—"Repairs, Additions, Alterations and Special Rules."

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.05 Reporting boiler and unfired pressure vessel locations. (1) The owner or user of any boiler or unfired pressure vessel shall report the location of such vessels unless either of the following conditions are met:

(a) The vessels are exempt from periodic inspections. See section Ind 41.21.

(b) The vessels are subjected to periodic inspection by the industrial commission, a city, an insurance company, or a company authorized to make its own inspections.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.06 Identification of boilers and unfired pressure vessels. (1) The owner or user of a boiler or unfired pressure vessel shall number each vessel in some permanent manner and in an accessible location.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.08 Certificate of competency as inspector. (1) **CERTIFICATE REQUIRED.** An inspection report covering a boiler or unfired pressure vessel may be recognized and accepted only when the inspector holds a valid certificate of competency issued by the industrial commission.

(2) **ELIGIBILITY.** (a) The applicant for a certificate of competency as a boiler or unfired pressure vessel inspector shall be an employee of the state, a municipality, an insurance company, or a corporation or company authorized to make its own inspections.

(b) The applicant shall be at least 25 years of age. He shall have had at least 3 years of experience in one or more of the following

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endeavors: construction, repairing, inspecting, operating engineer in charge of high pressure steam boilers or unfired pressure vessels.

(c) A degree in mechanical engineering may be accepted as the equivalent of two years practical experience.

(d) The applicant's employer shall certify that applicant's statement of experience is correct.

(3) APPLICATIONS AND RENEWALS. (a) Fees for examination and reciprocal certificates of competency shall be submitted with applications and in the amount specified in chapter Ind 69, Wis. Adm. Code.

(b) Renewal fees shall be submitted with the request for renewal and in the amount specified in chapter Ind 69, Wis. Adm. Code.

(c) A request for renewal shall be filed with the industrial commission on or before January 1 of the calendar year for which the certificate is to be valid.

(d) Applications for examination and applications for renewals by employees of the state and employees of the city of Milwaukee require no fee.

(4) EXAMINATIONS. (a) Certificates of competency for a boiler or unfired pressure vessel inspector may be issued by the industrial commission to eligible applicants passing the examinations prescribed by and conducted by the commission.

(b) Holders of certificates, who do not apply for renewal in any 3 year period may be required to pass a scheduled examination.

(5) ANNULMENTS AND REVOCATIONS. (a) A certificate becomes invalid when the holder terminates his employment with the employer of record at the time of issue. A renewal may be obtained under the provisions of this section provided applicant meets eligibility requirements.

(b) A certificate may be annulled or revoked when incompetency or negligence is determined after investigation.

(6) RECIPROCAL COMMISSIONS. (a) A reciprocal certificate of competency may be granted by the industrial commission to a boiler or unfired pressure vessel inspector under the following conditions:

1. The inspector shall be employed by a boiler insurance company licensed to do business in Wisconsin. The boiler insurance company shall make the application for a reciprocal commission to the industrial commission.

2. The inspector shall hold a commission issued by the National Board of Boiler and Pressure Vessel Inspectors or a certificate of competency from a city or state which has adopted the A.S.M.E. Boiler and Pressure Vessel Code and which holds a written examination similar to that required by Wisconsin.

3. The inspector shall appear before an examining board appointed by the industrial commission to review his qualifications as an inspector.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.11 Boiler blow-down equipment. (1) The blow-down from a boiler or boilers that enters a sewer system or blow-down which is considered a hazard to life or property shall pass through some form of blow-off equipment that will reduce pressure and temperature as required hereinafter.

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(2) The temperature of the water leaving the blow-off equipment shall not exceed 140 F.

(3) The pressure of the blow-down leaving any type of blow-off equipment shall not exceed 5 psi.

(4) The blow-off piping and fittings between the boiler and the blow-off tank shall comply with sections Ind 41.50 and Ind 41.51 of this code.

(5) The tank shall be designed in accordance with sections Ind 41.50 and Ind 41.51 of this code for a working pressure of at least one-fourth the maximum working pressure of the boiler to which it is connected.

(6) All blow-off equipment, except centrifugal blow-down separators, shall be fitted with openings to facilitate cleaning and inspection.

Note. Blow-off equipment designed in accordance with the boiler blow-off equipment code issued by the National Board of Boiler and Pressure Vessel Inspectors, 1957 edition, will meet the requirements of this section. Other methods of designing blow-off equipment may be used if approved by the industrial commission.

(Available for inspection at the office of the industrial commission and the secretary of state's office and the office of the revisor of statutes or may be procured for personal use from the National Board of Boiler and Pressure Vessel Inspectors, 1155 N. High Street, Columbus, Ohio.)

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.12 Vessels supplied through pressure reducing valves. (1) The following formula shall be used for determining the sizes of safety and relief valves on unfired pressure vessels such as pressure cookers, indirect hot water heaters, equipment in heating systems, etc., which are supplied through pressure reducing valves from boilers carrying a higher steam pressure:

$$RVC = \frac{1}{3} \times OC \times VSPA.$$

Where RVC = relief valve capacity, lbs. of steam per hour.

OC = orifice capacity, lbs. of steam per hour per square inch. (See Table 1)

VSPA = valve size pipe area, sq. in. (See Table 2)

Note. Most pressure reducing valves are arranged with a valved by-pass which also acts as a potential steam source hazard in case the by-pass is left open. Where such valved by-pass is used, the following formula shall be used to determine the steam flow rate through the by-pass:

$$RVC = \frac{1}{2} \times OC \times BPA.$$

Where RVC = relief valve capacity, lbs. of steam per hour.

OC = orifice capacity, lbs. of steam per hour per square inch. (See Table 1)

BPA = By-pass pipe area, sq. inch. (See Table 2)

The larger of the relief valve capacities calculated by the above two formulas shall be used for selecting the relief valve for the vessel.

Example:

Suppose a high pressure boiler operating at 125 psi distributes steam to a series of 40 psi A.S.M.E. constructed retorts through a 1½ inch size pressure reducing valve provided with a glove-valved 1 inch by-pass. Determine the proper A.S.M.E. relief valve protection for the retorts. Utilizing data in Tables and the first of the two formulas above:

$$W = \frac{1}{3} \times 7200 \times 2.04 = 4896 \text{ lbs. steam per hour.}$$

Checking the by-pass steam flow according to the second formula gives:

$$W = \frac{1}{2} \times 7200 \times 0.86 = 3100 \text{ lbs. steam per hour.}$$

The potential steam flow through the pressure reducing valve is 4896 lbs. per hour rated capacity or 4896 × 1000 or 4,896,000 Btu per hour.

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TABLE 1

ORIFICE RELIEVING CAPACITIES, LB. PER HR. PER SQ. IN., FOR DETERMINING THE PROPER SIZE OF RELIEF VALVES USED ON LOW PRESSURE SIDE OF REDUCING VALVES

Outlet Pressure, psi	Pressure-reducing valve inlet pressure, psi								
	125	100	85	75	60	50	40	30	25
110	4550								
100	5680								
85	6640	4070							
75	7050	4980	3150						
60	7200	5750	4540	3520					
50	7200	5920	5000	4230	2680				
40	7200	5920	5140	4630	3480	2470			
30	7200	5920	5140	4630	3860	3140	2210		
25	7200	5920	5140	4630	3860	3340	2580	1485	
15	7200	5920	5140	4630	3860	3340	2330	2320	1800
10	7200	5920	5140	4630	3860	3340	2330	2320	2060
5	7200	5920	5140	4630	3860	3340	2330	2320	2060

TABLE 2

INTERNAL PIPE AREA

Nominal pipe size, inches	STANDARD		
	Actual external diameter, inches	Approx. internal diameter, inches	Approx. internal area square inches
3/8	0.675	0.49	0.19
1/2	0.840	0.62	0.30
3/4	1.050	0.82	0.53
1	1.315	1.05	0.86
1 1/4	1.660	1.33	1.50
1 1/2	1.900	1.61	2.04
2	2.375	2.07	3.36
2 1/2	2.875	2.47	4.78
3	3.5	3.07	7.39
3 1/2	4.0	3.55	9.89
4	4.5	4.03	12.73
5	5.563	5.05	19.99
6	6.625	6.07	28.89
8	8.625	8.07	51.15
10	10.750	10.19	81.55
12	12.750	12.09	114.80

Note. In applying these rules, the area of the pipe is always based upon standard weight pipe and the inlet size of the pressure-reducing valve.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

PART IV

INSPECTIONS

Ind 41.20 Periodic inspections required. (1) INSPECTION OF BOILERS. Except as regulated in Ind 41.21, boilers shall be subjected to either a regular internal or external inspection at least once every 12 months by a qualified inspector.

(2) INSPECTION OF UNFIRED PRESSURE VESSELS. Except as regulated in Ind 41.21, unfired pressure vessels shall be subjected to a regular internal or external inspection at least once every 24 months by a qualified inspector.

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(3) **WHEN INTERNAL INSPECTION IS NOT POSSIBLE.** Where an internal inspection is not possible because of the construction of the boiler or pressure vessel, an external inspection will be acceptable.

(4) **EXTENSION OF PERIOD BETWEEN INSPECTIONS.** If operating conditions require, longer periods between inspections of boilers and unfired pressure vessels may be approved by the industrial commission upon a written request for an extension.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.21 Vessels exempt from periodic inspections. The following boilers and unfired pressure vessels will not be subject to periodic inspection, but in individual cases any such vessel will be subject to inspection by or on order of the commission upon complaint of any person or upon initiative of the commission when there is reasonable cause to suspect that the construction, installation, maintenance or operation of the vessel is not in keeping with the general purpose and intent of this code:

(1) Boilers or unfired pressure vessels which receive regular inspections by United States government inspectors.

(2) Steam boilers or unfired pressure vessels having an internal or external operating pressure not exceeding 15 psi with no limitations to size. Hot water boilers and their expansion tanks having an internal operating pressure not exceeding 30 psi with no limitations to size.

(3) Boilers used exclusively for agricultural purposes.

(4) Miniature boilers.

(5) Unfired pressure vessels having an inside diameter not exceeding 6 inches with no limitation to pressure.

(6) Unfired pressure vessels having a volume of less than 5 cubic feet and an operating pressure of less than 250 psi.

(7) Unfired pressure vessels with a volume of less than 1½ cubic feet with no limit on pressure.

(8) Unfired pressure vessels which are used in accordance with the regulations of the interstate commerce commission.

(9) Air receivers having a volume not to exceed 12 cubic feet and an operating pressure of less than 225 psi.

(10) Hot water supply boilers and hot water storage tanks.

(11) Vessels used for the storage or processing of cold water including those with air cushions.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.22 Preparation for internal inspections. The owner or user of a boiler or an unfired pressure vessel subject to inspection shall prepare the vessel for internal inspection after due notice from the inspector. To prepare a vessel for an internal inspection, all handhole, manhole plates and washout plugs shall be removed. The shell and heads shall be thoroughly cleaned and exposed when so requested. Each steam boiler shall be thoroughly drained of hot water and the combustion chamber and furnace cleaned out before an internal inspection is made.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.23 Insurance company inspections. Periodic inspections of boilers and unfired pressure vessels by insurance companies may be accepted by the industrial commission under the following conditions:

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(1) The boiler and pressure vessel inspectors employed by the insurance company shall hold certificates of competency issued by the industrial commission.

(2) The insurance company shall report inspections of boilers and unfired pressure vessels to the industrial commission as required in section Ind 41.26.

(3) The inspection procedures used by the insurance company shall conform to the regulations of this code.

(4) The insurance company shall report to the industrial commission within 30 days when insurance coverage is started or discontinued on a boiler or unfired pressure vessel. The reason for discontinuing the coverage shall be given on the report.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.24 Inspections by cities. Periodic inspections of boiler and unfired pressure vessels by cities of the first class may be accepted by the industrial commission under the following conditions:

(1) The boiler and pressure vessel inspectors employed by the city shall hold certificates of competency issued by the industrial commission.

(2) The city shall keep a record of such periodic inspections.

(3) The inspection procedures used by the city shall conform to the regulations of this code.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.25 Companies or corporations allowed to make inspections. Periodic inspections by companies or corporations of boilers or unfired pressure vessels which they own or operate may be accepted by the industrial commission under the following conditions:

(1) The boiler and pressure vessel inspectors employed by the company or corporation shall hold certificates of competency issued by the industrial commission.

(2) The company or corporation shall report inspections of boilers and unfired pressure vessels to the industrial commission as required in section Ind 41.26.

(3) The inspection procedures used by the company or corporation shall conform to the regulations of this code.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.26 Reporting of inspections. (1) Reports of periodic internal inspections shall be sent to the industrial commission within 30 days from the date of the inspection.

(2) External inspections shall be reported only when either of the following conditions is found:

(a) An internal inspection is not possible because of the construction of the vessel. In such cases the first inspection shall be reported to the commission in the same manner as an internal inspection. The report shall be marked "external" and the reason for making an external inspection instead of an internal shall be given.

(b) When violations of this code or unsafe conditions involving the safety of the vessel are found. This report shall be made on A.S.M.E. Form P-6 and shall explain the violation or unsafe condition with references to code section numbers. A copy of the recommendations to the owner or user of the vessel shall accompany the report to the commission.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

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Ind 41.27 Inspection report forms. (1) **FIRST INTERNAL INSPECTION.** The first internal inspection (or external if internal is not possible) of a boiler or pressure vessel which conforms to the A.S.M.E. Code shall be reported on A.S.M.E. Form P-6. If the boiler or pressure vessel does not conform to the A.S.M.E. Code Form P-5 shall be used. The first inspection report shall be as complete as possible and shall contain the maximum allowable working pressure, number of safety valves and their settings and capacities, and the known violations of this code.

(2) **SUBSEQUENT INSPECTIONS.** After the report of the first internal or external inspection has been sent to the commission, the subsequent reports may be copies of the report of inspection made to the owner or user of the vessel. Such reports shall show the location identifying number or description, safe working pressure, and safety or relief valve setting of the boiler or unfired pressure vessel. Such report shall give recommendations for correction of known violations of this code.

(3) **MULTIPLE VESSELS ON A SINGLE REPORT.** A group of unfired pressure vessels of the same design and use that are interconnected or are operated so as to form a unit, machine, or apparatus may be included in a single report. The report shall contain the number, description, and use of the vessels.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.28 Inspection certificates. (1) After each periodic internal inspection, the city, insurance company, or company or corporation shall issue an inspection certificate to the owner or user of the boiler or unfired pressure vessel.

(2) The inspection certificate shall give the maximum allowable working pressure for the vessel. Such pressure shall be determined using the regulations of the code.

(3) The inspection certificate shall be valid until the next required periodic inspection.

(4) The inspection certificate shall be kept on file by the owner or user of the boiler or unfired pressure vessel and shall be available when called for by a deputy of the industrial commission.

(5) For unfired pressure vessels, the inspection report made to owner or user may be used as the inspection certificate if the report is so marked.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

PART V

NEW INSTALLATIONS ORIGINAL CONSTRUCTION

Ind 41.50 A.S.M.E. code vessels. (1) Except as regulated in sections Ind 41.51, 41.52, and 41.53, boilers and unfired pressure vessels installed after the effective date of this section (Ind 41.50) shall be con-

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structed and installed in accordance with the following sections of the A.S.M.E. boiler and pressure vessel code:

(a) Section I	Power boilers	1959 Edition	As amended to Jan. 1, 1961
(b) Section III	Material specifications	1959 Edition	As amended to Jan. 1, 1961
(c) Section IV	Low pressure heating boilers	1959 Edition	As amended to Jan. 1, 1961
(d) Section V	Miniature boilers	1959 Edition	As amended to Jan. 1, 1961
(e) Section VIII	Unfired pressure vessels	1959 Edition	As amended to Jan. 1, 1961
(f) Section IX	Welding qualifications	1959 Edition	As amended to Jan. 1, 1961

Note 1. Copies of the above publications are available for inspection at the office of the industrial commission, secretary of state's office, and the office of the revisor of statutes or they may be procured for personal use from the American Society of Mechanical Engineers, 29 West 39th Street, New York 18, N.Y.

Note 2. Because the A.S.M.E. references are subject to revision and amendment, this section of the code will be amended at intervals. It is recommended that holders of this code subscribe to the upkeep service available from the revisor of statutes, State Capitol, Madison, Wisconsin.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.51 Wisconsin special vessels. (1) Where it is not possible or practical to construct a boiler or unfired pressure vessel in strict compliance with the A.S.M.E. codes listed in section Ind 41.50, the industrial commission may grant a modification to the owner or user to permit the installation of the vessel as a Wisconsin special within the state of Wisconsin under the following conditions:

(a) When the method of designing or constructing the vessel is not covered by the A.S.M.E. codes, the commission may approve the installation of the vessel if adequate proof of comparable safety of the design or construction is shown.

1. Complete plans, calculations, and specifications in duplicate shall be submitted to and approved by the commission before the vessel is installed.

2. The vessel shall be stamped "Wisconsin Special".

3. All other applicable requirements of the A.S.M.E. codes listed in section Ind 41.50 shall be met.

(b) When the vessel is to be built by an owner for his own use, the commission may waive the stamping required by the A.S.M.E. codes listed in section Ind 41.50.

1. Complete plans, calculations, and specifications in duplicate shall be submitted to and approved by the commission before the vessel is installed.

2. The vessel shall be stamped "Wisconsin Special".

3. All other applicable requirements of the A.S.M.E. codes listed in section Ind 41.50 shall be met.

(c) When a small number of vessels is to be built by a manufacturer, the commission may waive the stamping required by the A.S.M.E. codes listed in section Ind 41.50.

1. Complete plans, calculations, and specifications in duplicate shall be submitted to and approved by the commission before the vessel is installed.

2. The vessel shall be stamped "Wisconsin Special".

3. All other applicable requirements of the A.S.M.E. codes listed in section Ind 41.50 shall be met.

(2) The provisions of this section shall not apply to Wisconsin special vessels accepted by the industrial commission before the effective date of this section.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.52 Interstate commerce commission vessels. (1) Unfired pressure vessels carrying the stamping of the I.C.C. will be considered comparable to a vessel meeting the requirements of section Ind 41.50. When such vessels are used in the state of Wisconsin, it shall be the responsibility of the owner of the vessels to have the construction records of the vessels available for inspection by the industrial commission.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.53 Non-Code vessels. (1) The following vessels will only be required to meet the pressure-relief device requirements of the A.S.M.E. codes listed in section Ind 41.50.

(a) Water heating apparatus, such as range boilers or tanks having a self-contained gas, oil, or electric heating unit used exclusively for hot water service provided such apparatus carries a seal of approval from a testing agency recognized nationally and by the commission. The term "hot water service" shall be construed to mean a system in which the hot water is used for general cleaning purposes as in the bath, the laundry, and in the kitchen.

1. This exception shall not apply when the apparatus is used as a hot water heating boiler.

(b) Vessels for containing water under pressure for domestic supply including those having an air space for expansion.

(c) Hot water storage tanks, when heated indirectly by circulating either steam at or below 15 psig, or by hot water at or below 30 psig through a coil or heat exchanger, and the storage water temperature does not exceed 200 F.

(d) Pressure vessels used for water conditioning and filtration.

(e) The vessels listed in paragraphs (b), (c) and (d) of this section shall be identified by stamping showing the manufacturer's name, a serial number, the allowable working pressure, and the year fabricated.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.54 Low water fuel cut-off for hot water heating boilers. Every automatically fired hot water heating boiler installed after the effective date of this section with a heat input of more than 200,000 Btu per hour shall be provided with an automatic low-water fuel cut-off so located as to automatically cut off the fuel supply when the surface of the water falls to the lowest safe water line. The lowest safe water line shall be at or above the height required on a corresponding steam boiler.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

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PART VI

EXISTING INSTALLATIONS

Ind 41.60 Application. (1) The provisions of sections Ind 41.60 through Ind 41.99 shall apply to boilers installed prior to January 1, 1957.

(2) Unfired pressure vessels installed prior to January 1, 1957 shall meet the requirements of section Ind 41.99, pressure relief devices for unfired pressure vessels.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.61 Maximum allowable working pressures. (1) The maximum allowable working pressure on a boiler is the safe pressure at which the boiler may be operated as determined by the provisions of sections Ind. 41.60 through Ind 41.99, inclusive, of this code.

(2) No boiler shall be operated at a pressure in excess of the maximum allowable working pressure for such boiler.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.62 Code constructed vessels. Any boiler that has been constructed and stamped in accordance with the rules and regulations of the A.S.M.E. boiler and pressure vessel code, or other recognized codes, or has the standard stamping of another state that has adopted the standard of construction of the A.S.M.E. boiler and pressure vessel code, shall be allowed and may be operated at the maximum working pressure stamped on its shell providing the vessel is unaltered, in good working order, and not deteriorated by age or corrosion. For unstamped boilers, the operating pressure shall be determined by using sections Ind 41.63 through Ind 41.76, inclusive.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.63 Pressure calculations for shells. The maximum allowable working pressure to be allowed on the shell of a boiler shall be determined from the following formula:

$$P = \frac{T.S. \times t \times E}{R \times F.S.}$$

where P = maximum allowable working pressure, pounds per square inch,

T.S. = tensile strength of shell plate, pounds per square inch,

t = minimum thickness of shell plates, inches,

E = efficiency of longitudinal joint—method of determining which is given in section Ind 41.73,

R = inside radius of the outside course of the shell,

F.S. = lowest factor of safety allowed by section Ind 41.70.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.64 Pressure calculations for flat heads and flat surfaces. The maximum allowable working pressure on flat surfaces of boilers shall be determined by the following formula:

$$P = \frac{T.S. \times t^2}{0.5 \times d^2 \times F.S.}$$

where P = maximum allowable working pressure, pounds per square inch,

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T.S. = tensile strength of plate, pounds per square inch,
 t = thickness of plate, inches,
 d = diameter of head or shortest unsupported span of head or
 maximum pitch between stays, inches,

F.S. = lowest factor of safety allowed by section Ind 41.70.

Note. No allowance will be made for the holding power of flanges.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.65 Pressure calculations for dished heads. The maximum allowable working pressure on unstayed dished heads shall be determined by the following formula:

Pressure on concave side (plus head)

$$P = \frac{2 \times T.S. \times E \times t}{8.33 \times L}$$

Pressure on convex side (minus head)

$$P = \frac{2 \times T.S. \times E \times t \times 0.6}{8.33 \times L}$$

where t = thickness of plate, inches,

P = maximum allowable working pressure pounds per square inch,

T.S. = tensile strength pounds per square inch,

L = radius to which the head is dished,
 measure on the concave side of the head, inches,

E = efficiency of weakest joint used in forming the head (exclusive of the joint to the shell) for seamless heads,

E = 1.00.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.66 Dished head restrictions. Dished heads without skirts or flanges shall not be used for any pressure.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.67 Pressure calculation for furnaces and circular flues. The maximum allowable working pressure on furnaces of vertical boilers and circular flues shall be determined as indicated in sections Ind 41.50 and Ind 41.51 of this code.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.68 Boiler plate thickness. (1) The minimum thickness of any boiler plate under pressure shall be $\frac{1}{4}$ inch except that boiler plate in stayed surfaces shall be $\frac{1}{8}$ inch thick minimum.

(2) Seamless shells for miniature boilers may be constructed of $\frac{3}{16}$ inch boiler plate.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.69 Other methods of installing safety devices and other appliances. Where the A.S.M.E. codes listed in Ind 41.50 permit other methods of installing safety devices and other appliances on boilers, these methods may be used on existing boilers.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

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Ind 41.70 Factor of safety. Maximum allowable working pressure shall be determined by using a factor of safety of at least 5 except as provided in section Ind 41.62.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.71 Strength of materials. When the tensile strength of materials is not known, it shall be taken as 55,000 pounds per square inch for steel and 45,000 pounds per square inch for wrought iron, 30,000 pounds per square inch for copper and 18,000 pounds per square inch for cast iron. The resistance to crushing of mild steel shall be taken as 95,000 pounds per square inch of cross sectional area.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.72 Shearing strength of rivets. (1) MAXIMUM PER SQUARE INCH. The maximum shearing strength of rivets per square inch of cross-sectional area shall be taken as follows:

	Ultimate strength Pounds per square inch
Iron rivets in single shear -----	38,000
Iron rivets in double shear -----	76,000
Steel rivets in single shear -----	44,000
Steel rivets in double shear -----	88,000

(2) RIVET DIMENSIONS AFTER DRIVING. When the diameter of the rivet holes in the longitudinal joints of a boiler is not known, the diameter and cross-sectional area of rivets, after driving, shall be taken from Table 3.

TABLE 3

Thickness of Plate	$\frac{1}{4}''$ 0.25''	$\frac{3}{8}''$ 0.2812''	$\frac{5}{8}''$ 0.3125''	$\frac{3}{4}''$ 0.34375''	$\frac{7}{8}''$ 0.375''	$\frac{1}{2}''$ 0.375''	$\frac{13}{16}''$ 0.40625''
Diameter of Rivet after Driving	$\frac{1}{8}''$	$\frac{1}{8}''$	$\frac{3}{4}''$	$\frac{3}{4}''$	$\frac{3}{4}''$ up to and including 2'' pitch	$\frac{1}{2}''$ Over 2'' pitch	$\frac{1}{8}''$
Cross sectional area of rivet after driving	0.3712 sq. in.	0.3712 sq. in.	0.4418 sq. in.	0.4418 sq. in.	0.4418 sq. in.	0.5185 sq. in.	0.5185 sq. in.
Thickness of Plate	$\frac{7}{16}''$ 0.4375''	$\frac{7}{16}''$ 0.4375''	$\frac{13}{16}''$ 0.46875''	$\frac{1}{2}''$ 0.5''	$\frac{9}{16}''$ 0.5625''	$\frac{5}{8}''$ 0.625''	
Diameter of Rivet after Driving	$\frac{7}{8}''$ up to and including 2 $\frac{1}{4}''$ pitch	$\frac{1}{2}''$ over 2 $\frac{1}{4}''$ pitch	$\frac{1}{2}''$	$\frac{1}{2}''$	1 $\frac{1}{16}''$	1 $\frac{1}{16}''$	
Cross sectional area of rivet after driving	0.6013 sq. in.	0.6903 sq. in.	0.6903 sq. in.	0.6903 sq. in.	0.8866 sq. in.	0.8866 sq. in.	

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

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Ind 41.73 Efficiency of joint. The efficiency of a joint is the ratio which the strength of the joint bears to strength of the solid plate, and shall be determined as follows:

(1) For riveted joints, calculate according to sections Ind 41.50 and Ind 41.51 of this code using the values stated in sections Ind 41.71 and Ind 41.72.

(2) For welded joints, calculate by reference to Table 4.

TABLE 4
MAXIMUM ALLOWABLE EFFICIENCIES FOR FUSION
WELDED JOINTS

Type of Joint	Limitations	Maximum Joint Efficiency Per Cent
Double-Welded Butt Joint	None	80
Single-Welded Butt Joint with Backing Strip	Longitudinal joints not over 1¼" thick. No thickness limitations on circumferential joints.	80
Single-Welded Butt Joint without Backing Strip	Circumferential joints only not over ⅝" thick.	70
Double-Welded Full-Fillet Lap Joint	Longitudinal joints not over ⅜" thick. Circumferential joints not over ⅝" thick.	60
Single-Welded Full-Fillet Joints with Plug Welds	Circumferential joints only not over ⅝" thick and for attachments of heads not over 24" outside diameter to shells not over ⅝" thick.	50
Single-Fillet Joint without Plug Welds	For attachments to heads convex to pressure to shell not over ⅝" thick, only with use of fillet weld on inside shell; for attachments to heads having pressure on either side, with fillet weld on outside of head flange only, to shells not over 24" inside diameter and not over ¼" required thickness.	50
Forged Weld	None	70
Brazed Steel	None	80
Brazed Copper	None	90

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.74 Ligament between parallel tube holes. When a shell or drum is drilled for tube holes in a line parallel to the axis of the shell or drum, the efficiency of the ligament between the tube holes shall be determined as shown in sections Ind 41.50 and Ind 41.51 of this code.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.75 Ligaments between diagonal tube holes. When a shell or drum is drilled for tube holes in a line diagonal with the axis of the shell or drum, the efficiency of the ligament between the tube holes shall be determined as shown in sections Ind 41.50 and Ind 41.51 of this code.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.76 Maximum pressure for cast iron boilers. (1) The maximum allowable working pressure on a steam boiler constructed wholly or principally of cast iron shall not exceed 15 pounds per square inch.

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(2) The maximum allowable working pressure on boilers, the tubes of which are secured to cast iron headers, shall not exceed 160 pounds per square inch.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.77 Safety or relief valves required on boilers. Every boiler shall have one or more safety or relief valves set at or below the maximum allowable working pressure. On power boilers the remaining valves may be set at a higher pressure in accordance with section Ind 41.78.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.78 Safety valves for low pressure steam, miniature and power boilers. (1) Every boiler shall be provided with safety valve capacity sufficient to discharge all the steam that can be generated without an increase over the maximum allowable working pressure or to which the valve is set, except a 6% increase while the valve is discharging for power and miniature boilers, and a 5 pound per square inch increase while the valve is discharging for low pressure steam boilers.

(2) The steam generating capacity of a boiler in pounds of steam per hour may be determined by one of the following:

- (a) Manufacturer's maximum output rating.
- (b) Pounds of steam

$$\text{per hour} = \frac{\text{Maximum Btu input per hour} \times 0.75}{1000}$$

(c) Actual evaporation test.

(d) On the basis of boiler heating surface or waterwall heating surface as given in Table 5.

TABLE 5
MINIMUM POUNDS OF STEAM PER HOUR PER SQUARE
FOOT OF SURFACE

Type of Boilers	Surface	Firetube Boilers	Watertube Boilers
Power Boilers.....	Boiler heating surface		
	Hand-fired.....	5	6
	Stoker-fired.....	7	8
	Oil, gas, or pulverized fuel fired...	8	10
	Waterwall heating surface		
	Hand-fired.....	8	8
Stoker-fired.....	10	12	
Oil, gas, or pulverized fuel fired...	14	16	
Low Pressure Steam and Miniature Boilers.....	Boiler heating surface any method of firing.....	5	5*

*Shall include cast iron boilers.

Note. Compliance with section Ind 41.78 (1) will be required in every case.

(3) On power boilers one or more safety valves on the boiler proper shall be set at or below the maximum allowable working pressure. The remaining valves may be set within a range of 3% above the maximum allowable working pressure, but the range of setting of all of

the valves on a boiler shall not exceed 10% of the highest pressure to which any valve is set.

(4) Safety valves which are constructed in accordance with the standards as specified in sections Ind 41.50 and Ind 41.51 of this code are acceptable. Safety valves constructed to other standards may be used if approved by the industrial commission. Dead-weight or weighted-lever safety valves shall not be used.

(5) When 2 or more safety valves are used on a boiler, they may be mounted either separately or as twin valves made by placing individual valves on Y-bases, or duplex, triplex, or multiplex valves having 2 or more valves in the same body casing. The valves shall be made of equal sizes, if possible, and in any event if not of the same size, the smaller of the two valves shall have a relieving capacity of at least 50% of that of the larger valve.

(6) The safety valve or valves shall be connected to the boiler independent of any other steam connection, and attached as close as practical to the boiler, without any unnecessary intervening pipe or fitting. Every safety valve shall be connected so as to stand in an upright position, with spindle vertical, when possible.

(7) The opening or connection between the boiler and the safety valve or valves shall have at least the area of the inlet of the valve or valves. No valve of any description shall be placed between the required safety valve or valves and the boiler, nor on the discharge pipe between the safety valve and the atmosphere. When a discharge pipe is used, the cross-sectional area shall be not less than the full area of the valve outlet or of the total of the areas of the valve outlets discharging thereinto, and shall be as short and straight as possible and so arranged to avoid undue stresses on the valve or valves.

(a) All safety-valve discharges shall be so located or piped as to be carried clear from running boards, platforms, or otherwise carried to a safe location.

(b) Provision for gravity drain shall be made in the discharge pipe, at or near each safety valve, and where water or condensation may collect.

(8) (a) The spring in a safety valve in service for pressures up to and including 250 pounds shall not be used for any pressure more than 10% above or 10% below that for which it was designed. For higher pressures, the spring shall not be used for any pressure more than 5% above or 5% below that for which it was designed.

(b) If the operating conditions of a valve are changed so as to require a new spring for a different pressure, the valve shall be adjusted by the manufacturer or his authorized representative who shall furnish and install a new name plate.

(9) Every superheater shall have one or more safety valves near the outlet. The discharge capacity of the safety valve or valves on an attached superheater may be included in determining the number and size of the safety valves for the boiler, provided there are no intervening valves between the superheater safety valve and the boiler, and provided the discharge capacity of the safety valve or valves on the boiler, as distinct from the superheater, is at least 75% of the aggregate valve capacity required. A soot-blower connection may be attached to the same outlet from the superheater that is used for the safety valve connection.

(10) (a) Every boiler shall have outlet connections for the required safety valve or valves, independent of any other outside steam connection. The area of the boiler opening or openings shall be at least equal to the aggregate areas of inlet connections of all of the safety valves to be attached thereto. An internal collecting pipe, splash plate, or pan may be used, provided the total area for inlet of steam thereto is not less than twice the aggregate areas of the inlet connections of the attached safety valves. The holes in such collection pipes shall be at least $\frac{1}{4}$ " in diameter and the least dimension in any other form of opening for inlet of steam shall be $\frac{1}{4}$ ".

(b) If safety valves are attached to a separate steam drum or dome, the opening between the boiler proper and the steam drum or dome shall be not less than required by section Ind 41.78 (10) (a).

(c) When boilers allowed different pressures are connected to a common steam main and all safety valves are not set at the lowest pressure allowed, no safety valve shall be set to exceed by more than 50% the lowest pressure allowed.

(d) For conditions exceeding those specified in the above paragraph, the case shall be referred to the industrial commission for decision.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.79 Water-relief valves for hot water boilers. (1) Each hot water boiler shall have one or more relief valves of the spring loaded type, without disk guides on the pressure side of the valve. The valves shall be set to relieve at a pressure at or below the maximum allowable working pressure of the boiler.

(2) Relief valves which are constructed in accordance with sections Ind 41.50 and Ind 41.51 of this code are acceptable. Relief valves constructed to other standards may be used if approved by the industrial commission.

(3) Water-relief valves shall be attached directly or as close as possible to the boiler without any unnecessary intervening pipe or fitting. A water-relief valve shall not be connected to an internal pipe in the boiler. Water-relief valve shall be connected so as to stand upright with the spindle vertical when possible.

(4) No shut-off of any description shall be placed between the water-relief valve and the boiler, nor on discharge pipes between such valve and the atmosphere.

(5) When a discharge pipe is used its area shall be not less than the area of the valve or aggregate area based on the nominal diameters of the valves with which it connects. The discharge pipe shall be pitched away from the valve to prevent water from lodging in the upper part of the valve or in the pipe. The water-relief valve shall be so located and piped that there will be no danger of scalding attendants.

(6) The required water-relief valve capacity for any hot water boiler shall be equal to the maximum Btu output at the boiler nozzle or shall be equal to the boiler heating surface multiplied by 5000.

(7) The water-relief valve capacity for each hot water boiler shall be such that the valve or valves will relieve all the pressure that can be generated by the boiler without allowing the pressure to rise more than 3 pounds above the maximum allowable working pressure of the boiler.

(8) Every boiler shall have proper outlet connections for the required water-relief valves, independent of any other connection outside the boiler. The area of the opening or openings shall be at least equal to the aggregate area based on the nominal diameters of all of the water-relief valves with which it connects.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.80 Thermometers for hot water boilers. Every hot-water boiler shall have a thermometer so located and connected that it shall be easily readable when observing the water pressure or altitude. The thermometer shall be so located that it shall at all times indicate the temperature in degrees Fahrenheit of the water in the boiler, at or near the outlet.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.81 Water glass. Every low pressure steam, miniature and power boiler shall have at least one water glass, equipped with a valved drain, the lowest visible part of which shall be at or above the following location except that in all cases it shall be so placed as to give adequate protection to those parts of a boiler proper subject to the heat of the products of combustion:

(1) Horizontal return tubular boilers—not less than 4 inches above the upper surface of the upper row of tubes except when the distance between the uppermost surface of the tubes and the top of the steam space is 13 inches or less the distance may be reduced to 2 inches.

(2) Locomotive type boilers—3 inches above the highest part of the crown sheet.

(3) Vertical fire tube boilers—not less than $\frac{3}{8}$ the length of the tube above the lower tube sheets.

(4) Water tube boilers—as specified by the manufacturer.

(5) Scotch marine type boilers—3 inches above the combustion chamber top.

Note. For Dry Back see section Ind 41.81 (1).

(6) Cast iron boilers—as specified by the manufacturer.

(7) Other types and designs—for other types and new designs the location shall be fixed by the manufacturer subject to approval by the industrial commission.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.82 Gage cocks. (1) Every steam boiler, except those exempted below, shall have 3 gage cocks located within the range of the visible portion of the water glass.

(2) The following boilers shall not be required to have gage cocks:

(a) Boilers which do not have a definite water level.

(b) Boilers which have 2 water glasses spaced not less than 2 feet apart on the same horizontal line.

(c) Boilers which have 2 remote water level indicators in addition to the required water glass.

(d) Miniature boilers.

(3) The following boilers shall be required to have only 2 gage cocks:

(a) Low pressure steam boilers.

(b) Locomotive type boilers not over 36 inches in diameter.

(c) Firebox or water leg boilers in which the water heating surface does not exceed 50 square feet.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.83 Water column piping. (1) No connections shall be placed on pipes connecting the water column to the boiler except connections for damper regulator, feed water regulator, steam gage or drains.

(2) The minimum size of the pipes connecting the water column to a boiler shall be 1 inch. Water-glass fittings or gage cocks may be connected direct to the boiler.

(3) The water connections to the water column of a boiler, when practicable, shall be provided with a cross at each right-angle turn to facilitate cleaning. The water column shall be fitted with a drain cock or drain valve with a suitable connection to the ashpit or other safe point of waste, and if the water connection thereto has a rising bend or pocket which cannot be drained by means of the water column drain, an additional drain shall be placed in this connection in order that it may be blown off to clear any sediment from the pipe.

(4) The steam connection to the water column of a horizontal-return tubular boiler shall be taken from the top of the shell or the upper part of the head; the water connection shall be taken from the front head at a point not less than 6 inches below the center line of the shell. For the firebox types of boilers, the water connection to the water column shall be taken at a point not less than 6 inches below the lowest water line or as near thereto as possible, and in no case less than 18 inches above the mud ring.

(5) When shut-offs are used on the connections to a water column, they shall be either outside-screw-and-yoke type valves or stop cocks with levers permanently fastened thereto and marked in line with their passage. Where stop cocks are used they shall be of a type with the plug held in place by a guard or gland.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.84 Pressure gages. (1) (a) Every boiler shall be provided with a pressure gage connected to the upper part of the boiler and so arranged that the gage cannot be shut off from the boiler except that a shut-off valve or cock shall be placed close to the gage or a second shut-off valve or cock close to the boiler to permit removal for testing while the boiler is in operation.

(b) For steam boilers, the gage may also be connected to the water column or water column steam connection. For steam boilers, a siphon or equivalent device of sufficient capacity to keep the gage tube filled with water shall be provided.

(2) The dial of the pressure gage shall be graduated to at least one and one-half times the pressure at which the safety or relief valve is set except as follows:

(a) On low pressure steam boilers the gage shall be graduated to at least 30 pounds per square inch.

(b) On hot water boilers the pressure or altitude gage shall be graduated to at least one and one-half times the maximum allowable working pressure.

(3) (a) For low pressure steam boilers, the travel of the pointer from zero to 30 pounds per square inch shall be at least 4 inches.

(b) Effective stops shall be provided for the indicating pointer at the lowest and highest pressure points.

(4) The pressure gage dial shall at all times be protected by a transparent cover and shall be kept clear at all times. This gage should be so located as to be readily visible to the operator.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.85 Stop valves on pressure discharge outlets. (1) Each pressure discharge outlet on miniature and power boilers, except safety or relief valve outlets, shall be fitted with one or more stop valves located as near to the boiler as practicable. When 2 or more low pressure steam boilers are connected to a common header, a stop valve shall be provided in the steam outlet of each boiler as near to the boiler as practicable.

(2) When 2 stop valves are placed in the steam connection between a power boiler and the steam main there shall be a free blow drain between them. The discharge of this drain valve shall be visible to the operator while manipulating the valve.

(3) (a) When a stop valve is so located that water can accumulate, drains shall be provided.

(b) Each dry pipe or similar apparatus shall have two holes drilled into it. These holes shall be not less than $\frac{1}{2}$ " diameter each and shall be kept open so that the condensation can escape.

(4) Each superheater shall be equipped with at least one drain so located as will most effectively provide for the proper operation of the apparatus.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.86 Steam mains. Provision shall be made for the expansion and contraction of steam mains connected to boilers by providing substantial anchorage at suitable points so that there shall be no undue strain transmitted to the boiler. Steam reservoirs shall be used on steam mains when heavy pulsations of the steam currents cause vibration of the boiler shell plates.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.87 Bottom blow-off or drain. (1) Connected to the lowest space practicable of each boiler, there shall be a bottom blow-off pipe fitted with a valve or cock. The valves shall be of straightway or angle construction and cocks shall have the plugs held in place with a gland or guard. Straightway globe valves of the ordinary type or valves of such type that dams or pockets can exist for the collection of sediment, shall not be used on such connections.

(2) A surface blow-off shall not exceed $2\frac{1}{2}$ inch pipe size and the internal and external pipes, when used, shall form a continuous passage, but with clearance between their ends and arranged so that the removal of either will not disturb the other. A properly designed steel bushing or a flanged connection shall be used.

(3) (a) Each boiler shall have a bottom blow-off pipe, fitted with a valve or cock, in direct connection with the lowest water space practicable. The maximum size of pipe and fittings shall be $2\frac{1}{2}$ inches and the minimum size shall be 1 inch except that for boilers with 100 square feet of water heating surface or less and low pressure steam boilers the minimum size of pipe and fittings may be $\frac{3}{4}$ inch. Straightway globe valves of the ordinary type or valves of such type that dams or pockets can exist for the collection of sediment, shall not be used on such connections.

(b) The bottom blow-off pipe for low pressure steam, miniature, and hot water boilers may be connected to return connections which are the same size or larger than the size herein specified. In such case, the blow-off shall be so located that the connection may be completely drained.

(4) A bottom blow-off cock shall have the plug held in place by a guard or gland. The end of the plug shall be distinctly marked in line with the passage.

(5) (a) For power boilers, the bottom blow-off pipe or pipes shall be of wrought iron or steel and shall be at least extra heavy.

(b) The fittings between a power boiler and the required bottom blow-off valve or valves shall be of steel, cast steel or malleable iron and shall be not less than extra heavy construction for pressures not exceeding 150 pounds per square inch.

(c) For pressures exceeding 150 pounds per square inch such fitting shall be of steel construction and not less than extra heavy.

(d) Cast iron pipe and fittings shall not be used in the bottom blow-off pipe between the boiler and the bottom blow-off valve or valves.

(6) (a) On all boilers except those used for traction and portable purposes, when the maximum allowable working pressure exceeds 125 pounds per square inch, each bottom blow-off pipe shall have 2 slow-opening valves, or one slow-opening valve and a cock, and such valves, or valve and cock, shall be at least extra heavy construction. On a boiler having multiple blow-off pipes a single master valve may be placed on the common blow-off pipe from the boiler, in which case only one valve on each individual blow-off is required. Two independent valves, or a valve and a cock may be combined in one body provided the combined fitting is the equivalent of 2 independent valves, or a valve and a cock, so that the failure of one to operate could not affect the operation of the other.

(b) Every traction and portable boiler shall have a bottom blow-off valve; when the maximum allowable working pressure exceeds 125 pounds per square inch, the blow-off valve shall be at least extra heavy.

(c) For pressures exceeding 200 pounds per square inch the valves or cocks shall be of steel construction.

(d) The blow-off valve or valves shall be the full size of the blow-off pipe.

(7) A bottom blow-off pipe when exposed to direct furnace heat shall be protected by fire brick or other heat resisting material so arranged that the pipe may be inspected.

(8) An opening in the boiler setting for a blow-off pipe shall be arranged to provide for free expansion and contraction.

(9) See section Ind 41.11 for required boiler blow-down equipment.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.88 Feed pipe. (1) (a) Each low pressure steam, miniature and power boiler shall have the feed pipe fitted with a check valve

near the boiler and a stop valve between the check valve and the boiler. Single low pressure steam boiler installations of the gravity return type which do not have a stop valve in the steam outlet line will not be required to have a stop valve in the return pipe.

(b) On low pressure steam boilers, the return pipe loop connection shown in Fig. 1 may be used in place of the check valve.

(2) (a) The feed water shall be introduced into a boiler in such a manner that the water will not be discharged directly against surfaces exposed to gases of high temperature, or to direct radiation from the fire, or close to riveted joints of shell or furnace sheets.

(b) Where horizontal return tubular boilers are fed through the front, a boiler bushing or its equivalent shall be used and the feed water shall discharge at about three-fifths the length of the boiler from the front head, and above the second row of tubes from the top.

(3) When 2 or more power boilers are fed from a common source, there shall be a globe or regulating valve on the branch to each boiler, between the check valve and the source of supply. When 2 or more low pressure steam boilers, using a gravity return system are fed from a common source, one check valve may be placed on the main return pipe with a stop valve on the branch return to each boiler. Wherever globe valves are used on feed piping, the inlet shall be under the disk of the valve.

(4) (a) Means shall be provided for feeding a boiler against the maximum allowable working pressure or the pressure at which the safety valve is set to blow.

(b) Where a source of feed is available at a sufficient pressure to feed the boiler against a pressure 6% higher than that at which the safety valve is set to blow, this may be considered one of the means.

(5) Every boiler and its piping system shall be provided with a water supply line from an outside source of water supply in order to replace the water leaving the system through leakage, process work, or other reasons.

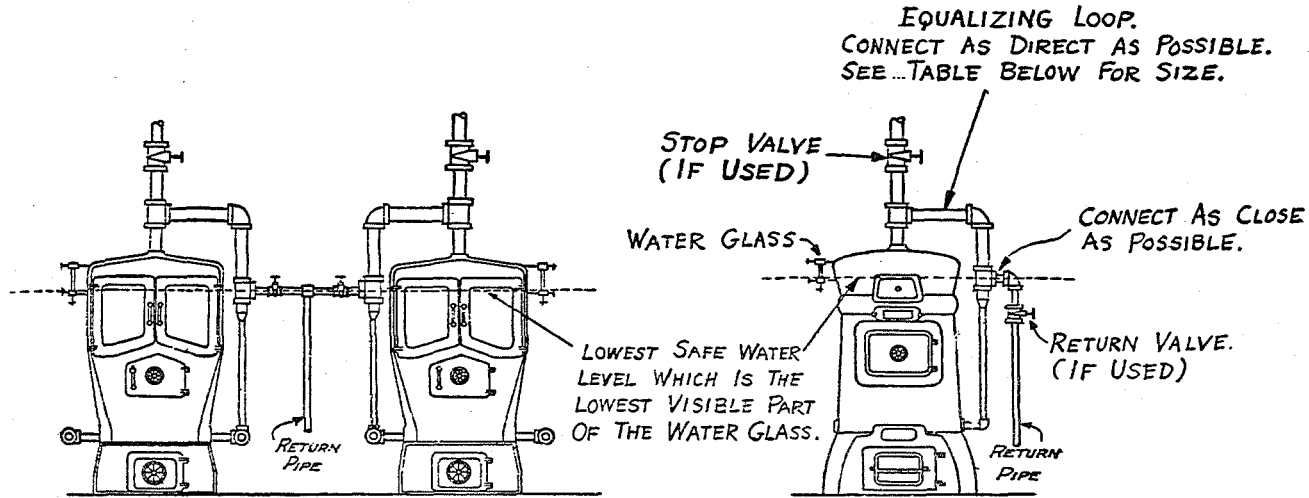
(a) A stop and check valve shall be provided in the water supply line with the stop valve closest to the boiler.

(b) On low pressure steam and hot water boilers, the water supply line shall be connected to the boiler return or feed piping system and not directly to the boiler.

(c) On low pressure steam, miniature, and hot water boilers, the water supply line pressure shall be high enough to feed the boiler or the system against the maximum allowable working pressure of the boiler.

(6) A heater for oil or other liquid harmful to boiler operation shall not be installed directly in the steam or water space within a boiler. Where an external type heater for such service is used, positive means such as double-transfer heaters or indicators such as fuel-oil indicators or sight glasses shall be provided to prevent the introduction into the boiler of oil or other liquid harmful to boiler operation.

Fig. 1
 RETURN PIPE LOOP CONNECTION



GRATE AREA, OR SQ. FT.	OR SAFETY VALVE CAP, LBS/HR	EQUALIZING LOOP SIZE, INCHES
4 OR LESS	250 OR LESS	1 1/2
OVER 4 TO 15	251 TO 2000 INC.	2 1/2
OVER 15	OVER 2000	4

Ind 41.89 Combustion regulators for boilers. (1) A temperature combustion regulator, which will control the rate of combustion to prevent the temperature of the water from rising above 250 F. at or near the outlet, or a thermostatic device which will relieve the pressure on the boiler when the temperature exceeds 250 F. shall be used on all hot water boilers.

(2) When a pressure combustion regulator is used on a steam boiler, it shall operate to prevent the steam pressure from rising above the maximum allowable working pressure for the boiler.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.90 Flanged connections. Openings in boilers having flanged connections shall have the flanges conform to the A.S.A. (American Standards Association) for the corresponding drilling for bolts or studs. Steel outlet nozzles and flanges may be riveted or welded to the shell. Cast iron outlet nozzles or flanges will be permitted only on low pressure steam or hot water boilers and can be attached to the shell only by riveting.

Note. Copies of the publication are available for inspection at the office of the industrial commission, secretary of state, and revisor of statutes or they may be procured for personal use from the American Standards Association, 10 East 40th Street, New York, New York.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.91 Washout and inspection openings. (1) All boilers shall be provided with suitable manhole or handhole openings, except special types where they are manifestly not needed or used.

(2) All horizontal fire tube boilers shall be required to have the following manhole or handhole openings:

(a) A manhole in the front head below the tubes for:

1. Horizontal return tubular power boilers over 54 inches in diameter.
2. Horizontal return tubular low pressure steam or hot water boilers over 60 inches in diameter.
3. For smaller boilers a handhole may be used in place of the manhole.

(b) A manhole in the upper part of the shell or head for:

1. Horizontal return tubular, fire box and locomotive power boilers over 48 inches.
2. Scotch marine power boilers over 54 inches in diameter.
3. Low pressure steam boilers over 60 inches in diameter.
4. For smaller boilers a handhole may be used in place of the manhole.

(c) Locomotive and fire box boilers shall also have the following handhole or washout openings:

1. One at each of the 4 corners of the lower portion of the water leg.
2. One in the front head at or about the line of the crown sheet.
3. One near the throat sheet of power boilers where possible.
4. One in the rear head of power boilers below the tubes.

(3) (a) A vertical fire tube boiler, except boilers 24 inches or less in diameter shall have not less than 4 handholes located as follows: 2 in the shell at or about the line of the crown sheet or lower tube sheet; 2 in the shell at the lower part of the water leg.

(b) Vertical fire tube boilers 24 inches or less in diameter shall have 3 one-inch diameter washout plugs except that boilers not exceeding

12 inches internal diameter having less than 10 square feet of water heating surface need not have more than 2 such washout plugs, one of which may be used for the attachment of the bottom blow-off valve. The threads of the washout plugs shall be of non-ferrous material.

(4) Where handholes are provided, such handholes shall not be less than 2½ inches by 3½ inches in size.

(5) Washout plugs, except for vertical fire tube boilers, shall be not less than 1½ inch pipe size and shall have threads of non-ferrous materials.

(6) Every cast iron boiler shall be provided with washout openings to permit the removal of any sediment that may accumulate therein. Washout openings may be used for return pipe connection if the washout plug is placed in a tee so that the plug is directly opposite and as close as possible to the opening in the boiler.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.92 Manholes. Where manholes are provided, such manholes shall be not less than 11 inches by 15 inches, or 10 inches by 16 inches in size. A circular manhole opening shall be not less than 15 inches in diameter.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.93 Maintenance. (1) All boilers shall be installed and maintained in such a manner as to prevent excessive corrosion or deterioration.

(2) The inspector shall note conditions during the internal inspection, external inspection or hydrostatic pressure test and order such changes or repairs as will place the boiler in a safe working condition.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.94 Threaded openings. (1) All pipe threads shall conform to the American Pipe Thread standard and all connections one inch pipe size or over shall have not less than the number of threads given in Table 6. For smaller pipe connections there shall be at least 4 threads in the opening.

(2) If the thickness of the shell of the boiler is not sufficient to give such number of threads a construction shall be employed which will provide at least the required number of threads.

**TABLE 6
MINIMUM NUMBER OF PIPE THREADS FOR CONNECTIONS
TO BOILERS**

Size of pipe connections, inches.....	1 & 1¼	1½ & 2	2½ to 4 incl	4½ to 6 incl	7 & 8	9 & 10	12
Number of threads per inch.....	11½	11½	8	8	8	8	8
Minimum number of threads required for opening.....	4	5	7	8	10	12	13
Minimum thickness of material required to give above number of threads, inches.....	0.348	0.435	0.875	1	1.25	1.5	1.6265

Note. Copies of the publication are available for inspection at the office of the industrial commission, secretary of state, and revisor of statutes or they may be procured for personal use from the American Standards Association, 10 East 40th Street, New York, New York, or the American Society of Mechanical Engineers, 29 West 39th Street, New York 18, New York.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Register, April, 1961, No. 64
Boiler and Unfired Pressure Vessel Code

Ind 41.95 Boiler setting and installation. (1) A horizontal return tubular boiler over 72 inches in diameter shall be supported from steel hangers by the outside suspension type of setting, independent of the boiler side walls. The hangers shall be so designed that the load is properly distributed between the rivets attaching them to the shell and so that no more than 2 of these rivets come in the same longitudinal line on each hanger. The distance girthwise of the boiler from the centers of the bottom rivets to the center of the top rivets attaching the hangers shall be not less than 12 inches. The other rivets used shall be spaced evenly between these points. If more than 4 hangers are used they shall be set in 4 pairs.

(2) A horizontal return tubular boiler over 54 inches and up to and including 72 inches in diameter, shall be supported by the outside suspension type of setting, or at 4 points by not less than 8 steel or cast iron brackets, set in pairs. A horizontal return tubular boiler up to and including 54 inches in diameter shall be supported by the outside suspension type of setting, or by not less than 2 steel or cast iron brackets on each side.

(3) Lugs or hangers, when used to support a boiler of any type shall be properly fitted to the surfaces to which they are attached. If riveted, the shearing and crushing stresses on the rivets used for attaching the lugs or hangers shall not exceed 8% of the strength given in section Ind 41.72. Where it is impractical to use rivets, studs with not less than 10 threads per inch may be used. In computing the shearing stress, the area at the bottom of the thread shall be used. Strength welding may be used, if done in accordance with sections Ind 41.50 and Ind 41.51 of this code.

(4) Wet bottom stationary boilers shall have a space of not less than 12 inches between the bottom of the boiler and the floor line, with access for inspection.

(5) The upper surface of the fire grate of an internally fired boiler of the open bottom locomotive, vertical fire tube or similar type, shall not be below the water space in the water leg, except where the rivets at the bottom of the water leg are protected from the action of the fire and products of combustion.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.96 Access and firing doors. The minimum size of an access door to be placed in a boiler setting shall be 12 inches by 16 inches or equivalent area, 11 inches to be the least dimension in any case.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.97 Water tube boiler doors. A water tube boiler shall have the firing doors, furnace inspection doors and clinker doors of the inward opening type, unless such doors are provided with latching or fastening devices or otherwise so constructed as to prevent them, when closed, from being blown open by pressure on the furnace side.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.98 Low-water cut-off and water feeder. (1) Every automatically fired power boiler which does not have a full time attendant and every automatically fired low pressure steam boiler shall be equipped with an automatic low-water fuel cut-off or other device which will perform a similar function, so located as to automatically cut off the fuel supply when the surface of the water falls to the lowest safe

water line. If a water feeding device is installed, it shall be so constructed that the water inlet valve cannot feed water into the boiler through the float chamber and so located as to supply requisite feed water. The lowest safe water line shall be not lower than the lowest visible part of the water glass.

(2) Such a fuel or feed water control device may be attached direct to a boiler or to the topped openings provided for attaching a water glass direct to a boiler, provided that such connections from the boiler are non-ferrous tees or Y's not less than $\frac{1}{2}$ inch pipe size between the boiler and the water glass so that the water glass is attached direct and as close as possible to the boiler; the straightway tapping of the Y or tee to take the water glass fittings, the side outlet of the Y or tee to take the fuel cut-off or water-feeding device. The ends of all nipples shall be reamed to full size diameter.

(3) Designs embodying a float and float bowl, or probe controls installed in a bowl or chamber externally to the boiler shall have a vertical straightway valved drain pipe at the lowest point in the water equalizing pipe connections by which the bowl or chamber and the equalizing pipe can be flushed and the device tested.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.

Ind 41.99 Pressure relief devices required for unfired pressure vessels. (1) Every unfired pressure vessel shall be provided with or protected by a pressure relief device.

(2) The relieving capacity of the pressure relief device shall be equal to or greater than the input to the vessel or shall be great enough to prevent the pressure in the vessel from rising more than 10% above the maximum allowable working pressure of the vessel.

(3) Safety valves which are constructed in accordance with the standards of sections Ind 41.50 and Ind 41.51 of this code are acceptable. Safety valves constructed to other standards may be used if approved by the industrial commission.

(4) Rupture disks may be used in lieu of safety valves on vessels containing substances that may render a safety valve inoperative, or where a loss of valuable material by leakage should be avoided, or contamination of the atmosphere by leakage of noxious gases must be avoided. Such rupture disks shall be tested, marked, and installed in accordance with the A.S.M.E. codes listed in section Ind 41.50.

(5) When hot water supply is heated indirectly by steam in a coil or pipe a water relief valve of at least one inch in diameter, set to relieve at or below the maximum allowable working pressure of the tank shall be used.

(6) Each safety or relief valve shall have a full size direct connection to the pressure vessel. When an escape pipe is used it shall be full sized and fitted with an open drain, to prevent water lodging in the upper part of the safety or relief valve or escape pipe. When a pressure vessel is fitted with 2 safety or relief valves on one connection, this connection to the pressure vessel shall have a cross-sectional area equal to or greater than the combined area of the 2 safety or relief valves. No valve of any description shall be placed between the safety or relief valve and the pressure vessel, nor on the escape pipe between the safety or relief valve and the atmosphere.

(7) When an elbow is placed on a safety or relief valve escape pipe it shall be located close to the safety or relief valve outlet, or the escape pipe shall be securely anchored and supported.

(8) When the capacity of the safety valve on an existing tank for containing gases is not known, the relieving capacity of such safety valve shall be determined from Table 7. Such safety valves shall not exceed 4 inches in diameter.

TABLE 7

MAXIMUM FREE AIR SUPPLIED IN CUBIC FEET PER MINUTE FOR DIFFERENT SIZES OF SAFETY VALVES AT STATED PRESSURES

Diameter of Valve (inches)	Gage pressure, pounds							
	50	100	150	200	250	300	350	400
1/4	20	32	42	51	59	67	74	53
1/2	37	59	78	96	112	127	141	111
3/4	58	94	124	152	178	202	224	176
1	84	135	180	221	259	293	325	248
1 1/4	114	186	248	302	354	400	444	
1 1/2	139	206	280	341	398	458	511	
2	182	267	356	428	502	578	655	
2 1/2	232	341	451	534	620	708	798	
3	293	433	576	680	790	904	1021	

Diameter of Valve (inches)	Gage pressure, pounds							
	500	600	800	1000	1200	1600	2000	2400
1/4	61	70	84	97	109	128	147	167
1/2	129	147	177	205	230	270	304	330
3/4	224	232	242	346	386	423	474	518
1	286	324	390	450	500	586		
1 1/4	374		509					
1 1/2	472		634					
2								
2 1/2								
3								

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61.