Chapter Ind 42

WELDED REPAIRS AND ALTERATIONS

PART I

WELDED REPAIRS AND ALTERATIONS

Ind 42.01 Rules and reports. (1) WELDED REPAIRS OR ALTERATIONS. Welded repairs or alterations to any boiler or pressure vessel or their fittings, settings, or appurtenances shall be completed in accordance with the requirements of sections Ind 42.01 through 42.22. Other methods may be acceptable provided they are approved by the department. In the absence of specific rules, the rules for new construction shall apply. No repair or alteration by welding shall be made without the approval of an Authorized Inspector who shall, if he considers it necessary, inspect the object before granting an approval.

(2) INSPECTION REPORTS. Manufacturers, owners, or contractors who make welded repairs or alterations in accordance with these rules shall

furnish the department with a report of every welded repair or alteration. The report shall be signed by the Authorized Inspector who inspected or approved the repair or alteration. The owner of the equipment shall retain a copy of the report for review by an Authorized Inspector. The form to be used for the report shall contain the information shown in the following example:

(3) EXCEPTIONS. The following items are exempt from the reporting requirements of (2):

(a) The welded repair of tubes, or the alteration or replacement of tubes in boilers or pressure vessels;

(b) Piping, nozzles, valves and fittings of 2-inch nominal pipe size and smaller.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61; r. and recr., Register, May, 1974, No. 221, eff. 6-1-74; am. (1) and (2), cr (3), Register, May, 1978, No. 269, eff. 6-1-78.

STATE OF WISCONSIN
DEPARTMENT OF INDUSTRY, LABOR AND HUMAN RELATIONS
INDUSTRIAL SAFETY & BUILDINGS DIVISION
201 E. Washington Avenue
Post Office Box 2209
Madison, Wisconsin 53701

Record of Repair or Alteration Completed on: Power Boiler ☐ Wis. Reg. No._____
Heating Boiler ☐ NB No._____
Pressure Vessel ☐ Serial No._____
Miniature Boiler ☐ Other_____
Mfg'd. by:_____

Work completed by contractor_____
(Name)
_____
(Address) (Zip)

Located in the plant of_____
(Name of Owner)
_____
(Address) (Zip)

_____
(Description of repair)

_____

_____

_____

_____

_____

_____

_____

Hydrostatic Test p.s.i._____

Repair or alterations were made in accordance with the requirements of the Wisconsin Department of Industry, Labor and Human Relations, Wisconsin Administrative Code Chapter 42. The welding was completed by_____
(Name of welder and Soc. Sec. #)
who has made the test requirements of said rules.

_____ Signed by_____
(Welding Process) (Contractor Representative)

_____ Dated at_____ On_____
(Welding Procedure)

_____ _____
Authorized Inspector--Wis. Com. # Employed by

_____
Date

Use reverse side for sketch description of repair or alteration.
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prepared and qualified in accordance with the requirements of ASME Section IX, Welding Qualifications (Ind 41.10) and section Ind 41.51 of this code.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61; r. and recr., Register, May, 1974, No. 221, eff. 6-1-74.

Ind 42.09 Welders. (1) WELDER QUALIFICATION. Manufacturers, owners or contractors shall have available for the inspector records of welder qualification tests showing that each welder to be employed on the work has satisfactorily passed tests as prescribed in section IX of the ASME code (table 41.10-A) for the type of filler metal to be used and for each position in which the welder will be called upon to operate in making the repair.

(2) WELDING TESTS, MANUFACTURER'S, OWNER'S OR CONTRACTOR'S RESPONSIBILITY, INSPECTOR'S DUTY. Preparation of welding procedure specifications and the conducting of tests of procedures and welders shall be the responsibility of the manufacturer, owner or contractor. Before repairs are started, it shall be the duty of the inspector to be satisfied by examination of the written welding procedure and records of qualification tests that procedures and welders have been properly qualified as required in section IX of the ASME code (table 41.10-A). Witnessing of the tests by the inspector shall not be mandatory but the inspector shall have the right to witness such tests when it is deemed necessary. The inspector shall also have the right to call for and witness the making of test plates by any welder, at any time, and to observe the physical testing of such plates.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61; am. (2), Register, May, 1974, No. 221, eff. 6-1-74; am. (1) and (2), Register, May, 1978, No. 269, eff. 6-1-78.

Ind 42.10 Rules for welding. The repairs that may be made under these rules are limited to steels of flange or fire box quality having known weldable quality and further limited to carbon steels having a carbon content of not more than 0.35%. Structural steel shall not be used. The welding of high alloy material and nonferrous material shall be done in accordance with the requirements of ASME Section IX, Welding Qualifications (Ind 41.10) and section Ind 41.51 of this code.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61; am., Register, May, 1974, No. 221, eff. 6-1-74.

Ind 42.11 Prohibited repairs. A welder shall not make repairs in a plate thickness in excess of that permitted under section IX of the ASME code (table 41.10-A) for welding qualifications. A welder shall not make repairs on a material that is not covered within the welder's qualification tests.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61; am. Register, May, 1978, No. 269, eff. 6-1-78.

Ind 42.12 Procedure. Groove welds shall completely penetrate the thickness of the material being welded. If possible, welding shall be applied from both sides of the plate or a backing strip or ring may be used to insure complete penetration. Manually applied welds shall have a convex surface on both sides if applied on both sides of the plates being joined, or on one side if welding is applied from one side only. Valleys and undercutting at edges of welded joints shall not be permitted. The

reinforcement may be chipped, ground, or machined off flush with the base metal, if so desired, after the welding has been completed.

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

Ind 42.13 Defective weld. In making a repair to a weld that has failed in service, the defective weld shall be removed by chipping, grinding or gouging until sound metal is reached on all sides. The resulting groove shall be filled as required by the applicable welding procedure.

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

Ind 42.14 Stress relieving operations. (1) In repairing carbon or low alloy steels, when required by these rules and considered necessary by the authorized inspector, thermal stress relieving shall be applied to the completed work. The heat may be applied by any means that will raise the temperature of the material being heated gradually and uniformly to approximately 1,200 F. (In the absence of more accurate means of determining temperature, a dull red glow in daylight will suffice.) This temperature shall be maintained for a period of one hour per inch of thickness of material. For circumferential joints, the area heated shall comprise a band extending completely around the cylinder and having a width on each side of the center line of the weld not less than 3 times the greatest width of the finished weld. For nozzles, the heated area shall comprise a circumferential band extending around the entire vessel, including the nozzle or welded attachment and shall extend at least 6 times the plate thickness beyond the welding which connects the nozzle or other attachment to the vessel. Under certain conditions other methods of thermal stress relieving acceptable to the authorized inspector may be used. Under certain conditions preheating may be necessary.

(2) Upon completion of the stress relieving operation, the plate shall be allowed to cool at a rate not greater than 500 F. per hour divided by the maximum thickness of the welded part in inches, but in no case more than 500 F. per hour. This rate of cooling shall be maintained until a temperature of approximately 600 F. is reached, after which normal cooling by exposure in a still atmosphere may be permitted.

(3) Thermal stress relieving of austenitic steels is a controversial subject. It shall not be attempted except in accordance with the recommendations of the manufactuurer of the material or the requirements of sections Ind 41.50 and Ind 41.51 of this code.

(4) In lieu of thermal stress relieving of carbon steels, peening or other methods acceptable to the authorized inspector may be employed.

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

Ind 42.15 Cracks, permissible welded repairs. CAUTION. Before making welded repairs, care should be taken to investigate the cause of the cracks. Where circumstances indicate that welding cracks is likely to result in recurrence, consideration should be given to cutting out the cracked area and installing a patch.

(1) Cracks in unstayed shells, drums or headers of boilers or pressure vessels may be repaired by welding, providing the cracks do not extend between rivet holes in a longitudinal seam or parallel to a rivet seam within 8 inches, measured from nearest calking edge. The total length of any one such crack shall not exceed 8 inches. Cracks of a greater length may be welded, provided the complete repair is radiographed and stress

relieved in accordance with section Ind 42.14. See Figures 8 and 8 (a) for acceptable methods.

(2) Cracks of any length in unstayed furnaces may be welded, provided the welds are thermally stress relieved in accordance with section Ind 42.14. Welds applied from both sides of the plate shall be used where possible. Welds applied from one side only shall be subject to the approval of the authorized inspector. Field repair of cracks at knuckle or turn of flange of furnace opening are prohibited unless specifically approved by the department. See Figure 9 for acceptable methods.

(3) Cracks of any length in stayed areas may be repaired by fusion welding except that multiple or star cracks radiating from rivet or staybolt holes shall not be welded. See Figure 10 for acceptable methods.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61; am. (2), Register, May, 1974, No. 221, eff. 6-1-74.

Ind 42.16 Corroded surfaces and seal welding. (1) Corroded areas in stayed surfaces may be built up by fusion welding, provided the remaining plate has an average thickness of not less than 50% of the original thickness, and further provided that the areas so affected are not sufficiently extensive to impair the safety of the object. See Figure 11 for acceptable methods.

(2) Corroded areas around manhole or handhole openings in either stayed or unstayed plates may be built up by fusion welding, provided the average loss of thickness does not exceed 50% of the original plate thickness and also provided the area to be so repaired does not extend more than 3 inches from the edge of the hole.

(3) Corroded areas in unstayed shells, drums or headers may be built up by fusion welding provided that in the judgment of the authorized inspector, the strength of the structure has not been impaired. See Figure 12 for acceptable methods.

(4) Edges of butt straps or of plate laps and nozzles or connections attached by riveting may be restored to original dimensions by welding. Seal welding shall not be used except with the special approval of the authorized inspector, and in no case where cracks are present in riveted areas. See Figure 13 for acceptable methods.

(5) The ends of tubes in fire tube and water tube boilers may be seal welded provided they have not been reduced more than 10% in thickness, and requirements of sections Ind 41.50 and Ind 41.51 of this code are satisfied. See Figure 14 for acceptable methods.

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

Ind 42.17 Re-ending and piecing tubes. Re-ending or piecing of tubes or pipes in either fire tube or water tube boilers is permitted provided the thickness of the tube or pipe has not been reduced by more than 10% from that required by sections Ind 41.50 and Ind 41.51 of this code for the pressure to be carried. In all cases the requirements of sections Ind 41.50 and Ind 41.51 of this code shall be met.

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

Ind 42.18 Patches, material. The material used for patches shall be of the same general quality and have at least the minimum physical properties of the plate to be patched. The thickness of any patch shall be

at least equal to, but not more than, ⅝ inch greater than the plate being patched.

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

Ind 42.19 Flush or butt welded patches. (1) Flush or butt welded patches in unstayed shells, drums or headers shall be radiographed and stress relieved to conform to the requirements of sections Ind 41.50 and Ind 41.51 of this code for new construction. Subject to the approval of an authorized inspector, peening or other methods of stress relieving may be substituted for thermal stress relieving. Subject to compliance with this requirement, no limit is placed on dimensions or location of such patches or on the thickness of the material. When the longest dimension of a patch does not exceed 16 times the plate thickness or a maximum of 8 inches, radiographing and stress relieving is not required. See Figure 15 for acceptable methods.

(2) Flush or butt welded patches or new sections may be applied to stayed plates without limitation of size or plate thickness. See Figure 16 for acceptable methods.

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

Ind 42.20 Lapped and fillet welded patches. Lapped and fillet welded patches may be applied to stayed plates provided they are not exposed to radiant heat. Lapped and fillet welded patches may be applied on the pressure side of the sheet in unstayed areas, provided the maximum diameter of the opening so repaired does not exceed 16 times the thickness of the plate, but in no case larger than 8 inches in diameter. See Figure 17 for acceptable methods.

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

Ind 42.21 Stays. (1) Threaded stays may be replaced by welded-in stays provided that in the judgment of the inspector the plate adjacent to the stay bolt has not been materially weakened by deterioration or wasting away. All requirements of the applicable section of sections Ind 41.50 and Ind 41.51 of this code governing welded-in stays shall be met, except that stress relieving other than thermal may be used as provided in section Ind 42.14.

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

Ind 42.22 Additional acceptable repair methods. Repairs and repair methods not discussed in the chapter shall comply with methods illustrated in Figures 18, 19, 20 and 21.

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

PART II
SECONDHAND BOILERS—SECONDHAND PRESSURE VESSELS—PORTABLE BOILERS

Ind 42.25 Application. Sections Ind 42.25 through Ind 42.33 shall apply to secondhand boilers, secondhand pressure vessels installed after July 1, 1960 on which both the ownership and location were changed, and shall also apply to portable boilers (See Ind 42.33).

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61; am. Register, May, 1974, No. 221, eff. 6-1-74.

Ind 42.32 Installation. All secondhand pressure vessels exclusive of vessels used for the storage and transportation of liquefied petroleum gases, anhydrous ammonia, and all refrigerant containing vessels when reinstalled shall comply with the ASME codes listed in section Ind 41.10 in regard to fittings, appliances, valves, connections, settings and supports. (The excluded vessels are subject to the provisions of other applicable administrative codes.)

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61; am., Register, May, 1974, No. 221, eff. 6-1-74.

Ind 42.33 Portable boilers. A portable boiler, when brought into this state for use, shall be given the inspection and test specified in section Ind 42.31 and the allowable working pressure shall be calculated using sections Ind 41.60 through Ind 41.99 unless it meets either of the following requirements:

(1) The boiler was constructed and stamped according to section Ind 42.26 code constructed vessels.

(2) The boiler is insured by a boiler insurance company.

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

PART III
INSPECTION AND REPAIR OF PRESSURE VESSELS IN PETROLEUM REFINERIES

Ind 42.35 Application. Sections Ind 42.35 through Ind 42.63 shall apply to the inspection, repair, evaluation for continued use, and the methods for computing the maximum allowable working pressure of pressure vessels in petroleum refineries.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61; am., Register, May, 1974, No. 221, eff. 6-1-74.

Ind 42.36 Inspection; general. (1) Vessels that are inspected in accordance with the procedures described herein will be acceptable; however, other procedures approved by the department may be used.

(2) New vessels shall be permitted to operate within the conditions for which they were constructed as determined in section Ind 42.40 or, in cases where the provisions of section Ind 42.39 (1) (c) apply, for an initial period during which corrosion rates are determined as specified in section Ind 42.39 (1) (c).

(3) If the vessel is to be kept in service the allowable conditions of service and the length of time before the next inspection shall be based on the condition of the vessel, as determined by the inspection.

(4) If the allowable working pressure and temperature are changed, the period of operation until the next inspection shall be established for this new service.

(5) If both the ownership and location of any vessel are changed, the vessel shall be inspected before it is re-used and the allowable conditions of service and the next period of inspection shall be established for the new service.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61; am. (1), Register, May, 1974, No. 221, eff. 6-1-74.

Ind 42.37 Qualifications of inspectors. (1) EXPERIENCE. Inspectors shall have at least 3 years experience as follows:

(a) In boiler or pressure vessel construction or repair;

(b) As an operating engineer in charge of high pressure boilers; or

(c) As an inspector of steam boilers or pressure vessels.

(2) EDUCATION. A degree in mechanical engineering will be accepted as the equivalent of 2 years practical experience.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61; am., Register, May, 1974, No. 221, eff. 6-1-74; r. and recr. Register, May, 1978, No. 269, eff. 6-1-78.

Ind 42.38 Inspection records. (1) A permanent and progressive record shall be maintained for each vessel. This record shall include the following:

(a) Manufacturer's and owner's serial numbers.

(b) Location and thickness for critical points at all inspections.

(c) Limiting metal temperature and location on vessel, if such temperature is below -20° F., or is a factor in establishing the allowable working pressure or other service conditions for the vessel.

(d) Computed maximum allowable working pressure at the time of the next inspection and coincident temperature,* and, in addition, if the vessel is rated by a code other than the one to which it was constructed, computations showing method of determining the maximum allowable working pressure with reference to the specific edition of the code or codes used.

(e) Hydrostatic test pressure if so tested at the time of inspection.

(f) Scheduled (approximate) date of next inspection.

(g) Date of installation and of any significant change in service conditions (pressure, temperature, character of contents, or rates of corrosion), for any vessels of the types mentioned in section Ind 42.38 (2) (b).

(2) In addition to the progressive vessel record described in section Ind 42.38 (1), a file which contains the following information shall be maintained:

(a) Complete safety valve data, including spring data, and date of latest inspection.

(b) For all vessels used in process operations and others subject to corrosive conditions, drawings giving sufficient details to permit calculation of service rating of all components.

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

Ind 42.39 Determination of probable corrosion rate. (1) On new vessels and on vessels for which service conditions are being changed,

* For a vessel designed for more than one combination of operating conditions, i.e., having more than one maximum allowable working pressure with coincident temperatures, or for a vessel in which different zones are subjected to different temperatures (see section Ind 41.50), all conditions should be recorded.

one of the following methods shall be employed to determine the probable rate of corrosion from which the remaining wall thickness at the time of the next inspection can be estimated:

(a) The corrosion rate as established by accurate data collected by the owner or user on vessels in the same or similar service.

(b) If accurate data for the same or similar service are not avail-