Chapter ILHR 42

REPAIRS, ALTERATIONS, MISCELLANEOUS REQUIREMENTS

Note: Chapter Ind 42 as it existed on April 30, 1961 was repealed and a new chapter Ind 42 was created effective 5-1-61. Chapter Ind 42 was renumbered to be chapter ILHR 42 effective 3-1-84.

PART I

WELDED REPAIRS AND ALTERATIONS

ILHR 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 ss. ILHR 42.01 through 42.17. 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 welded repair or alteration shall be made without the approval of an authorized inspector who shall, if it is considered necessary, inspect the object before granting an approval.

(2) ADDITIONAL REQUIREMENTS FOR ALTERATIONS. (a) Alterations to boilers and pressure vessels, with the exception of rerating with no physical change in the boiler or pressure vessel, shall be performed by an organization in possession of a valid ASME certificate of authorization, provided the alterations are within the scope of such authorization.

(b) 1. The organization responsible for the preparation of the report of alteration shall also be responsible for adding a nameplate to the boiler or pressure vessel.

2. The stamping or namplate shall be applied adjacent to the original manufacturer's stamping or nameplate in letters at least 5/32 inch high.

3. The nameplate for rerating when no physical change is made in the boiler or pressure vessel shall be as follows:

RERATED BY _____

_____ PSI AT _____ F
(MAWP) (Temp)

_____
(Date Rerated)

4. The nameplate for all other alterations to a boiler or pressure vessel shall be as follows:

ALTERED BY _____

_____ PSI AT _____ F
(MAWP) (Temp)

_____
(Manufacturer's Alteration Number, if used)

_____
(Date Altered)

(c) A copy of the original manufacturer's data report and any required manufacturer's partial data reports shall be a part of the completed report of alteration and shall be attached thereto. Where the manufacturer's data report is unavailable, documentation acceptable to the department shall be submitted.

(d) A pressure test shall be applied after the alteration has been completed, at a pressure of at least the operating pressure, but not to exceed 150% of the maximum allowable working pressure. In lieu of a pressure test, if approved by the authorized inspector, radiographic testing or ultrasonic testing may be utilized.

Note: Where water is used in a hydrostatic test, the temperature of the water should not be less than 70° F and the maximum temperature during inspection should not exceed 120° F. If a test is conducted at 1½ times the maximum allowable working pressure (MAWP) and the owner specifies a temperature higher than 120° F, the pressure should be reduced to the MAWP and the temperature to 120° F for the close examination.

(3) EXAMPLES OF REPAIRS. (a) Weld repairs or replacements of pressure parts or attachments that have failed in a weld or in the base material.

(b) The addition of welded attachments to pressure parts, such as:

1. Studs for insulation or refractory lining;

2. Hex steel or expanded metal for refractory lining;

3. Ladder clips;

4. Brackets;

5. Tray support rings;

6. Corrosion-resistant strip lining;

7. Corrosion-resistant weld overlay;

8. Weld buildup of wasted areas.

(c) Replacement of heat exchanger tube sheets in accordance with the original design.

(d) Replacement of boiler and heat exchanger tubes where welding is involved.

(e) In a boiler, a change in the arrangement of tubes in furnace walls, economizer or superheater sections.

(f) Replacement of pressure retaining parts identical to those existing on the boiler or pressure vessel and described on the original manufacturer's data report. For example:

1. Replacement of furnace floor tubes or sidewall tubes, or both, in a boiler.

2. Replacement of a shell or head in accordance with the original design.

3. Rewelding a circumferential or longitudinal seam in a shell or head.

4. Replacement of nozzles.

(g) Installation of new nozzles or openings of such a size that reinforcement is not a consideration. For example, the installation of a 3-inch pipe

size nozzle to a shell or head of ⅜-inch or less in thickness or the addition of a 2-inch pipe size nozzle to a shell or head of any thickness.

(h) The addition of a nozzle where reinforcement is a consideration may be considered to be a repair provided the nozzle is identical to one in the original design, is located in a similar part of the vessel, and is not closer than 3 times its diameter from another nozzle. The addition of such a nozzle shall be restricted by any service requirements.

(i) The installation of a flush patch to a boiler or pressure vessel.

(j) The replacement of a shell course in a cylindrical pressure vessel.

(k) Welding of gage holes.

(l) Welding of wasted or distorted flange faces.

(m) Replacement of slip-on flanges with weld neck flanges or vice versa.

(n) Seal welding of butt straps and rivets.

(4) EXAMPLES OF ALTERATIONS. (a) To increase the maximum allowable working pressure or temperature of a boiler or pressure vessel regardless of whether or not a physical change was made to the boiler or pressure vessel.

(b) The addition of new nozzles or openings in a boiler or pressure vessel except those classified as repairs.

(c) A change in the dimensions or contour of a pressure vessel.

(d) In a boiler, an increase in any heating surface which results in increasing the heat output or the final temperature above that specified in the original design.

(e) The addition of a pressurized jacket to a pressure vessel.

(f) Replacement of a pressure retaining part in a pressure vessel or a boiler with a material of different nominal strength or nominal composition from that used in the original design.

(g) A decrease in the minimum temperature such that additional mechanical tests are required as specified in ASME code section VIII.

(5) RECORD OF REPAIR OR ALTERATION. (a) Except as provided in par. (b), anyone making 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 report shall contain the information indicated on form SB-190.

(b) The following items are exempt only from the reporting requirements of par. (a):

1. The welded repair or replacement of tubes in boilers or pressure vessels; and

2. The welded repair or replacement of piping, nozzles, valves and fittings of 2-inch nominal pipe sizes and smaller.

(c) All other requirements of ss. ILHR 42.01 to 42.17 shall apply.

STATE OF WISCONSIN
DEPARTMENT OF INDUSTRY, LABOR AND HUMAN RELATIONS
SAFETY AND BUILDINGS DIVISION
201 East Washington Avenue
Post Office Box 7969
Madison, Wisconsin 53707

Record of Repair or Alteration
Completed on:

Power Boiler ☐ Wis. Reg. No. _____
Heating Boiler ☐ NB No. _____
Pressure Vessel ☐ Serial No. _____
Miniature Boiler ☐ Other _____

Mfd. by: _____

Work completed by contractor _____
(Name)

Address: _____
(Zip)

Located in the plant of _____
(Name of owner)

Address: _____
(Zip)

Description of repair: _____

(Use reverse side for sketch description of repair or alteration.)

Hydrostatic Test psig _____

Repair or alterations were made in accordance with the requirements of the Wisconsin Department of Industry, Labor and Human Relations, Wis. Adm. Code Chapter ILHR 42. The welding was completed by _____
(Name of Welder)

who has made the test requirements of said rules.

_____ Signed by _____
(Welding Process) (Contractor Representative)

_____ Dated _____
(Welding Procedure)

I, the undersigned, have inspected the work described in the report and state that to the best of my knowledge and belief, this work has been done in accordance with the requirements of Wis. Adm. Code Chapter ILHR 42. By signing this certificate, neither the inspector nor the inspector's employer makes any warranty, expressed or implied, concerning the work described in this report. Furthermore, neither the inspector nor the inspector's employer shall be liable in any manner for any personal injury or property damage or loss of any kind arising from or connected with this inspection, except such liability as may be provided in a policy of insurance which the inspector's insurance company may issue upon said object and then only in accordance with the terms of said policy.

_____ _____
Authorized Inspector—Wis. Com. No. Employed by

_____
Date

SB-190
Rev. 1979

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; r. and recr., Register, June, 1980, No. 294, eff. 7-1-80; am. form, Register, February, 1982, No. 314, eff. 3-1-82; r. and recr. (2) (b), cr. (4) (f) and (g), am. (5), Register, February, 1984, No. 338, eff. 3-1-84.

ILHR 42.02 Hydrostatic test or nondestructive testing. If, in the opinion of the authorized inspector, a hydrostatic test is necessary, such a test shall be applied at a pressure of at least the operating pressure, but not to exceed 150% of the maximum allowable working pressure. In lieu of a hydrostatic test, if approved by the authorized inspector, radiographic testing, ultrasonic testing, or other applicable nondestructive testing of the repair may be utilized. Such tests shall be applied after the repair has been completed.

Note: Where water is used in a hydrostatic test, the temperature of the water should not be less than 70° F and the maximum temperature during inspection should not exceed 120° F. If a test is conducted at 1-½ times the maximum allowable working pressure (MAWP) and the owner specifies a temperature higher than 120° F, the pressure should be reduced to the MAWP and the temperature to 120° F for the close examination.

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

ILHR 42.05 Welding procedure. Anyone undertaking repairs or alterations shall have available at the job site a written welding procedure specification acceptable to the authorized inspector that shall be followed in making the necessary repair and also a record of procedure qualification tests. Welding procedure specifications shall have been prepared and qualified in accordance with the requirements of section IX of the ASME code.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61; r. and recr., Register, June, 1980, No. 294, eff. 7-1-80.

ILHR 42.06 Welders. (1) WELDER QUALIFICATIONS. Anyone undertaking repairs or alterations shall have available at the job site 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.

(2) WELDING TESTS; RESPONSIBILITY; INSPECTOR'S DUTY. Preparation of welding procedure specifications and the conducting of tests of procedures and welders shall be the responsibility of the party undertaking repairs or alterations. Before repairs or alterations 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. Witnessing of the tests by the inspector shall not be mandatory but the inspector shall 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; r. and recr., Register, June, 1980, No. 294, eff. 7-1-80.

ILHR 42.07 Cracks, permissible welded repairs. A repair of a defect, such as a crack in a welded joint or base material, shall not be made until the defect has been removed. A suitable nondestructive examination method shall be used to assure complete removal of the defect. If the defect penetrates the full thickness of the material, the repair shall be

made with a complete penetration weld such as a double butt weld or a single butt weld with or without backing.

Note: Before repairing a cracked area, care should be taken to investigate its cause and to determine its extent. Where circumstances indicate that the crack is likely to recur, consideration should be given to removing the cracked area and installing a patch or other corrective measures.

(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 caulking 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 s. ILHR 42.14. See Figure 2 for acceptable methods.

(2) 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 2 for acceptable methods.

(3) Cracks of any length in unstayed furnaces may be welded, provided the welds are thermally stress relieved in accordance with s. ILHR 42.14. Welds applied from one side only shall be subject to the approval of the authorized inspector. Field repair of cracks at the knuckle or the turn of the flange of the furnace opening are prohibited unless specifically approved by the department. See Figure 3 for acceptable methods.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61; r. and recr., Register, June, 1980, No. 294, eff. 7-1-80.

ILHR 42.08 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 4 for acceptable welding methods.

(2) Corroded areas around manhole or handhole openings in either stayed or unstayed plates may be built up by fusion welding, provided that the average loss of the thickness does not exceed 50% of the original plate thickness and that the area to be repaired does not extend more than 3 inches from the edge of the hole nor closer than 2 inches to any knuckle. See Figure 5 for acceptable methods.

(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 6 for acceptable welding 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 7 for acceptable welding methods.

(5) Wasted flange faces may be cleaned thoroughly and built up with weld metal. They should be machined in place, if possible, to a thickness not less than that of the original flange or that required by calculations in accordance with the provisions of the applicable section of the ASME

code. Wasted flanges may also be remachined in place without building up with weld metal provided the metal removed in the process does not reduce the thickness of the flange to a measurement below that calculated above. Flanges that leak because of warpage or distortion and that cannot be repaired shall be replaced with new flanges that have at least the dimensions conforming to the applicable section of the ASME code.

(6) Tubes may be seal welded provided the ends of the tube have sufficient wall thickness to prevent burn-through and the requirements of the appropriate sections of the ASME code are satisfied. See Figure 8 for acceptable methods.

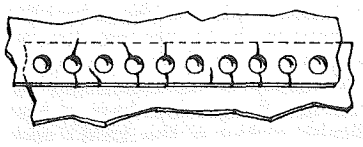
History: Cr. Register, April, 1961, No. 64, eff. 5-1-61; r. and recr., Register, May, 1974, No. 221, eff. 6-1-74; r. and recr., Register, June, 1980, No. 294, eff. 7-1-80.

ILHR 42.09 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 the applicable section of the ASME code.

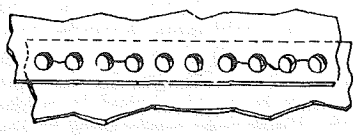
History: Cr. Register, April, 1961, No. 64, eff. 5-1-61; am. (2), Register, May, 1974, No. 221, eff. 6-1-74; am. (1) and (2), Register, May, 1978, No. 269, eff. 6-1-78; r. and recr., Register, June, 1980, No. 294, eff. 7-1-80.

ILHR 42.10 Materials. The materials used in making repairs or alterations shall conform to the requirements of the applicable section of the ASME code. Materials shall be of known weldable quality, have at least the minimum physical properties of the material to be repaired and be compatible with the original material. The thickness of any patch shall be at least equal to, but not more than ⅛-inch greater than, the material being patched. Carbon or alloy steel having a carbon content of more than 0.35% shall not be welded.

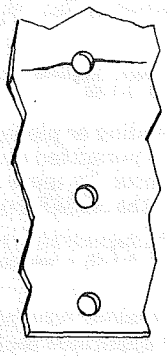
History: Cr. Register, April, 1961, No. 64, eff. 5-1-61; am., Register, May, 1974, No. 221, eff. 6-1-74; r. and recr., Register, June, 1980, No. 294, eff. 7-1-80.



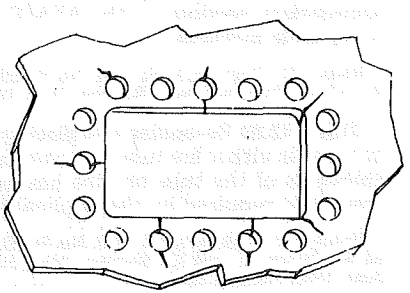
Fire Cracks at Girth Seams



Circumferential Cracks at Girth Seams



Cracks in Stayed Plates



Fire Cracks at Door Openings

Cracks radiating from rivet or staybolt holes may be repaired if the plate is not seriously damaged. If the plate is seriously damaged, it shall be replaced. A suggested repair method is described below:

a. Prior to welding, the rivets or staybolts from which the cracks extend and the adjacent rivets (or staybolts if appropriate) should be removed.

b. In riveted joints, tack bolts should be placed in alternate holes to hold the plate laps firmly.

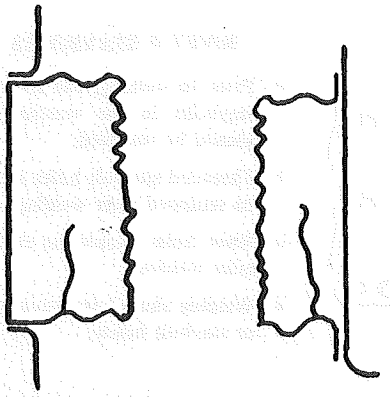
c. The cracks should then be prepared for welding by chipping, grinding or gouging.

d. In riveted joints, cracks which extend past the inner edge of the plate lap should be welded from both sides.

e. Rivet holes should be reamed before new rivets are driven.

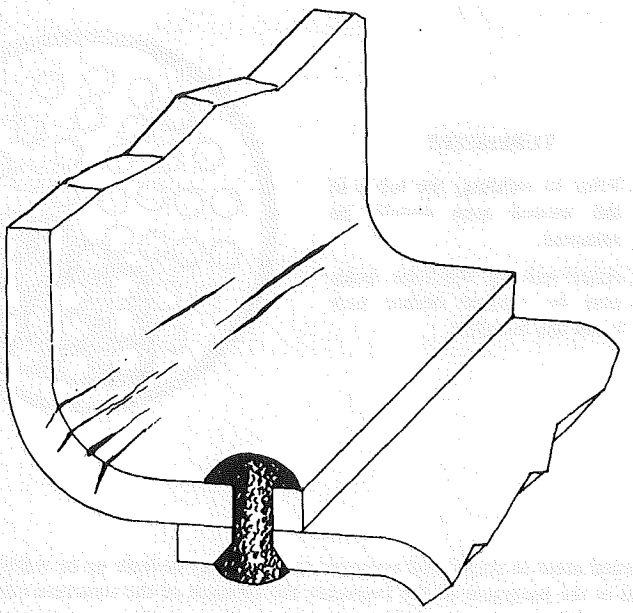
f. Threaded staybolt holes should be retapped and new staybolts properly driven and headed.

FIGURE 2 — RIVET AND STAYBOLT HOLE CRACKS



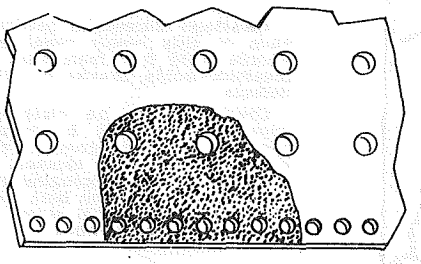
Caution: Successful performance of this repair requires a ductile weld free from slag inclusions, voids, cracks or other defects.

Cracks shall be chipped, ground or gouged to provide required welding groove; root of weld shall be cleaned by chipping or flame gouging and welding applied from both sides of the plate. Thermal stress relieving is recommended.



Cracks at the knuckle or at the turn of the flange of the furnace opening require immediate replacement of the affected area. If repairs are attempted, specific approval of the department is required.

FIGURE 3 — UNSTAYED BOILER FURNACES



RIVET & STAYBOLTS

a. Prior to welding, the rivets or staybolts in the wasted area should be removed.

b. Threaded staybolt holes should be retapped after welding.

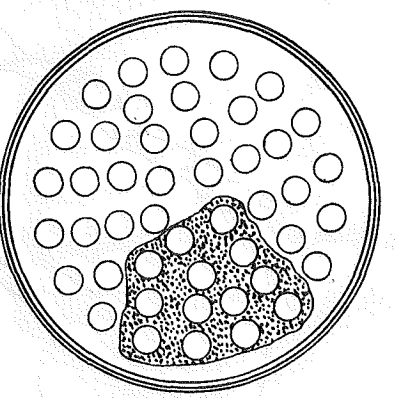
c. Rivet holes should be reamed after welding.

d. Welding should not cover rivet or staybolt heads.

TUBESHEET

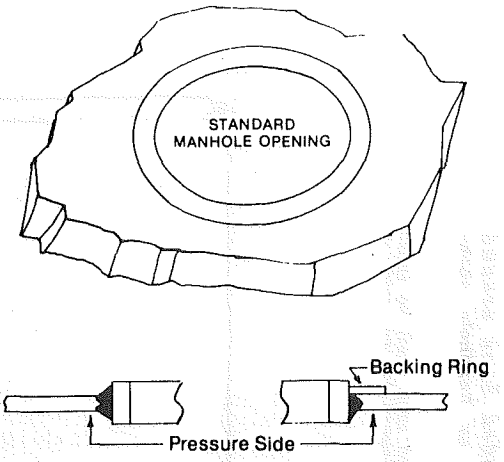
a. Prior to welding, the tubes in the wasted area should be removed.

b. After welding the tube holes may be reamed before new tubes are installed.

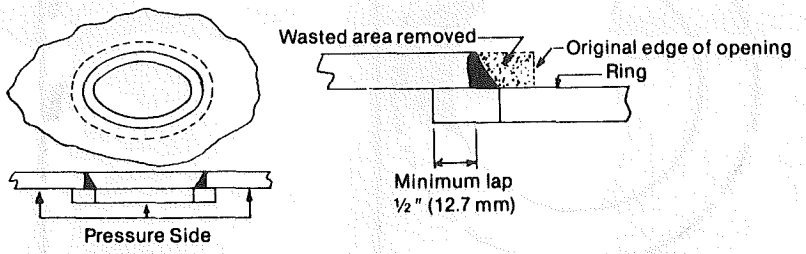


Wasted areas in stayed and unstayed surfaces may be built up by welding provided that in the judgment of the Inspector the strength of the structure will not be impaired. Where extensive weld build-up is employed, the Inspector may require an appropriate method of NDE for the complete surface of the repair.

FIGURE 4 — WELD BUILD-UP OF WASTED AREAS



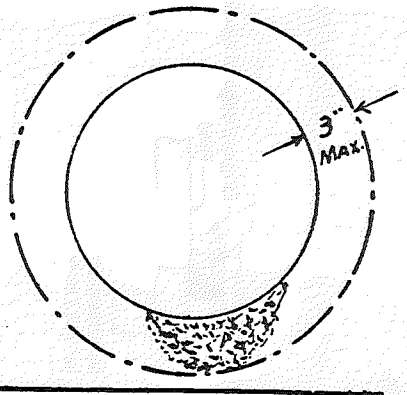
A badly wasted manhole flange may be removed and replaced with a ring-type frame as shown above. The requirements of 42.150 for flush patches shall be met. A full penetration weld is required. May either be double welded or welded from one side with or without a backing ring.



A badly wasted area around a handhole opening may be repaired by adding a ring as shown above on the inside of the object.

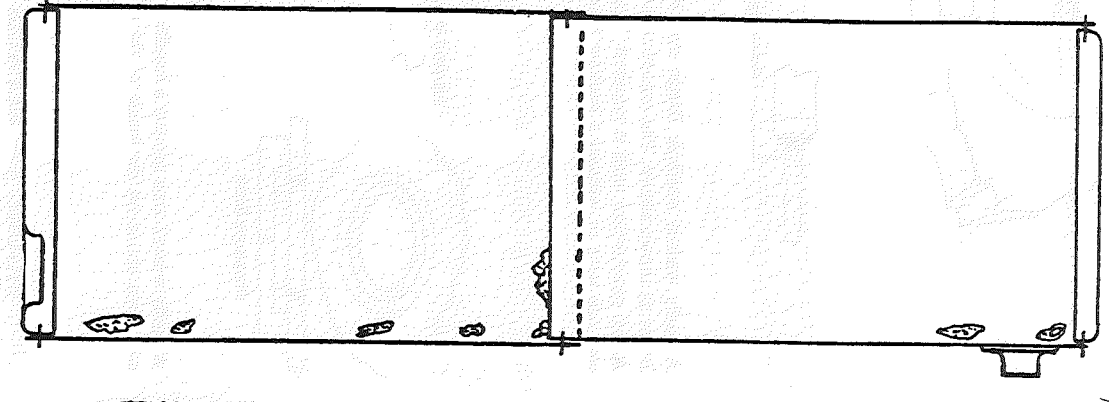
FIGURE 5 — REPAIRS FOR ACCESS OPENINGS

FIGURE 6--CORRODED AREAS



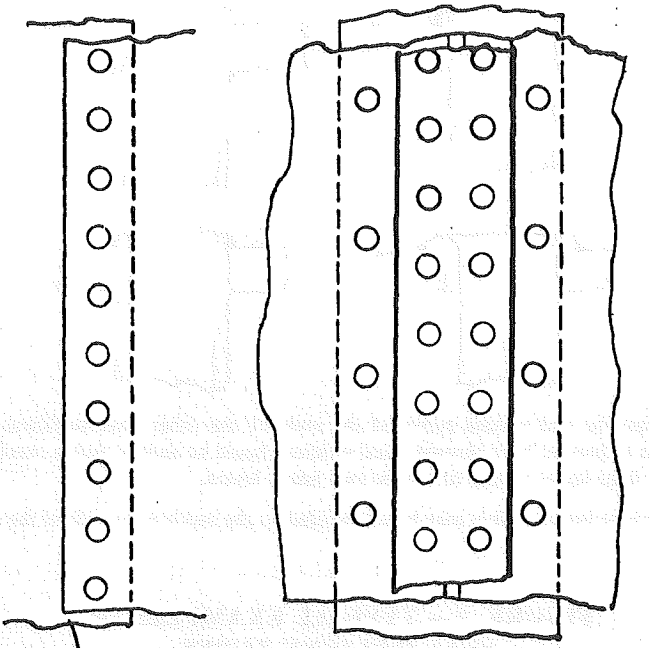
Corroded Area around manhole or handhole openings.

Corroded area shall be thoroughly cleaned before welding.



No corroded area which is shown in this sketch and which exceeds in size the permissible area of an unreinforced opening or exceeding in average depth 50% of the plate required thickness shall be "built up" by welding. Larger areas in vessels which are subject to internal corrosion or erosion but where the required thickness would be satisfactory for the pressure

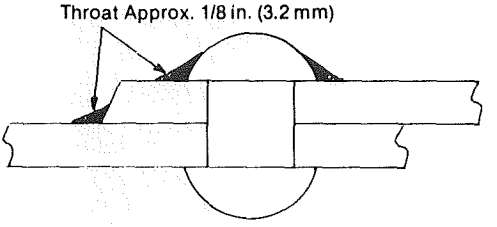
SEAL WELDING OF CAULKING EDGES



Caution.—Seal welding shall not be applied if cracks are present in riveted areas.

Indications of persistent or recurring leakage may be a sign of cracking. No welding shall be applied until a careful examination—including removal of rivets if necessary—has been made of such areas.

Seal welding shall be applied in one light layer if practicable but not more than two layers shall be used.

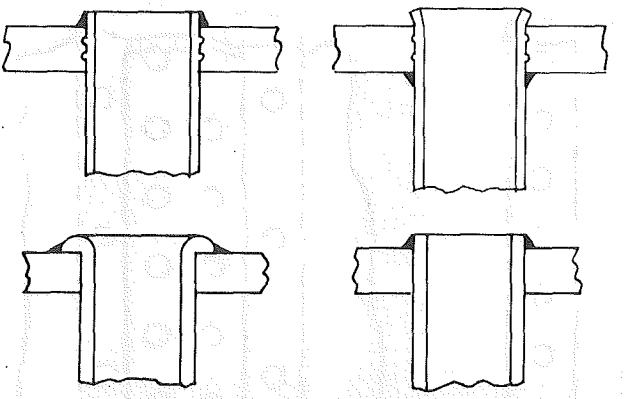


TYPICAL RIVET JOINT SHOWING SEAL WELD

Seal welding of riveted joints requires the approval of the jurisdiction. Seal welding shall not be considered a strength weld.

Prior to welding, the area should be examined by an appropriate method of NDE to assure that there are no cracks radiating from the rivet holes. If necessary, the rivets should be removed to assure complete examination of the area. Seal welding should not be performed if cracks are present in riveted areas.

FIGURE 7 — SEAL WELDING OF RIVETED JOINTS



Tubes may be seal welded provided the ends of the tubes have sufficient wall thickness to prevent burn through. Seal welding should be applied with a maximum of three light layers in lieu of one or two heavy layers.

In water tube boilers, tubes may be seal welded on the inside or outside of the tube-sheet.

FIGURE 8— TYPICAL EXAMPLES OF SEAL WELDING TUBES

ILHR 42.11 Replacement pressure parts. Replacement parts shall be classified as follows:

(1) PARTS ASSEMBLED BY FORMING. Replacement parts which will be subject to internal or external pressure and that consist of materials which may be formed or assembled to the required shape by bending, forging or other forming methods, but on which no shop fabrication welding is performed, may be supplied as material. Material and part identification shall be supplied in the form of bills of materials and drawings with ASME code compliance certified in a statement by the parts supplier.

Note: Examples include seamless or welded tubes or pipe supplied separately or in bundles; forged nozzles; heads or tube sheets forged or machined from a single piece of material; subassemblies of tubes or pipe attached together mechanically.

(2) WELDED PARTS NOT REQUIRING INSPECTION. Replacement parts which will be subject to internal or external pressure and that are preassembled by welding, but on which shop inspection is not required by the ASME code, shall have the welding performed in accordance with section IX and other applicable sections of the ASME code. The replacement part assembly identification shall be supplied in the form of bills of material and drawings. The supplier or manufacturer shall certify that the material, design and fabrication are in accordance with the applicable section of the ASME code.

Note: Examples include boiler furnace panel wall or floor assemblies; prefabricated openings in boiler furnace walls such as burner openings, air ports, inspection openings or soot blower openings.

(3) WELDED PARTS REQUIRING INSPECTION. Replacement parts which will be subject to internal or external pressure and that are fabricated by welding and which require shop inspection by an authorized inspector, shall be fabricated by a manufacturer having an ASME certificate of authorization and the appropriate code symbol stamp. The item shall be inspected, and stamped with the applicable code symbol and the word "PART". A complete manufacturer's partial data report shall be supplied by the manufacturer. When the part is added to the vessel, the partial data report is to be attached to Form SB 190 "Report of Welded Repair or Alteration".

History: Cr. Register, February, 1984, No. 338, eff. 3-1-84.

ILHR 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.

ILHR 42.13 Preheating. (1) GENERAL. Preheating may be required during welding to assist in completion of the welded joint. Where deemed necessary, advice shall be sought from a qualified source.

Note: See ASME code section VIII Appendix R for further explanatory information.

(2) PREHEAT AND INTERPASS TEMPERATURES. The welding procedure specification and qualification for the material being welded shall specify the preheat and interpass temperature requirements.

History: Cr. Register, February, 1984, No. 338, eff. 3-1-84.

ILHR 42.14 Postweld heat treatment. (1) GENERAL. In repairing carbon or low alloy steels, postweld heat treatment shall be required if it would be required for new construction by the ASME code or when considered necessary by the authorized inspector.

(2) ALTERNATIVE METHODS. Under certain conditions, postweld heat treatment as outlined above may be inadvisable or impractical. In such instances, any other method of postweld heat treatment or special welding method acceptable to the inspector may be used. Examples of special welding methods for P1 and P3 materials are described in sub. (3). Where deemed necessary, competent technical advice should be obtained from the manufacturer of the object or from another qualified source. When such procedures are used, the inspector shall be assured that the requirements of sub. (3) are met.

(3) WELDING METHODS AS ALTERNATIVES TO POSTWELD HEAT TREATMENT. Two welding methods that may be used as alternatives to postweld heat treatment are given below as a general guide. The use of these alternatives is limited to P1 and P3 steels, and to the more routine repairs required in boiler and pressure vessel maintenance. They should not be used in highly stressed areas, or if service conditions are conducive to stress corrosion cracking or, in some cases, to hydrogen enbrittlement.

(a) *Method 1, Higher preheat temperatures.* 1. *Material applicability:* P-No. 1, 3.

2. *Method details.* Preheat the materials to be welded to at least 300° F and maintain this temprature during welding. The 300° F temperature should be checked to assure that 4 inches of the steel on each side of the joint, or 4 times the plate thickness, whichever is greater, will be maintained at the minimum preheat.

Note: Preheat of carbon steel to the temperature range of 300° F to 400° F has been shown by some laboratory tests to be the equivalent of the conventional postheat temperature of 1200° F insofar as mechanical properties of the weldment are concerned. In the use of this method it should be ascertained that the notch ductility in the as welded condition is adequate at operating and pressure test temperatures. When this alternative meets the above requirements, any code credit for postweld heat treatment can be continued.

(b) *Method 2, Temper bead.* 1. *Material applicability:* P-No. 1, 3.

2. *Limitations.* a. The weld metal shall be deposited by the manual shielded metal arc process using low hydrogen electrodes. The maximum bead width shall be 4 times the electrode core diameter.

b. The depth of the repair shall not be greater than ⅜-inch or 10% of the base metal thickness, whichever is less, and the individual area shall not be greater than 10 square inches.

c. When the temper bead method is used, it shall require the approval of the department. The inspector shall assure that the method has been qualified in accordance with the guidelines of section IX of the ASME code.

3. *Method details.* a. Step 1. The weld area shall be preheated and maintained at a minimum temperature of 350° F during welding. The maximum interpass temperature shall be 450° F.

b. Step 2. The initial layer of weld metal shall be deposited over the entire area with ⅛-inch maximum diameter electrode. Approximately one-half the thickness of this layer shall be removed by grinding before depositing subsequent layers. Subsequent layers shall be deposited with a 5/32-inch maximum diameter electrode in a manner to ensure tempering of the prior beads and their heat affected zones.

c. Step 3. Heat input shall be controlled within a specified range.

d. Step 4. The weld area shall be maintained at a temperature of 400-500° F for a minimum period of 2 hours after completion of the weld repair.

(4) JOINTS BETWEEN AUSTENITIC STAINLESS STEELS. Postweld heat treatment is neither required nor prohibited for joints between austenitic stainless steels. It shall not be attempted except in accordance with the recommendations of the manufacturer of the material or the requirements of s. ILHR 41.10.

Note: See ASME code, section VIII, division 1, paragraph UHA-105.

(5) PEENING. In lieu of postweld heat treatment of carbon steels, peening or other methods acceptable to the authorized inspector may be used.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61; r. and recr., Register, June, 1980, No. 294, eff. 7-1-80.

ILHR 42.15 Welded patches. (1) FLUSH OR BUTT WELDED PATCHES. (a) The weld around a flush patch shall be a full penetration weld and the accessible surfaces shall be ground flush where required by the applicable section of the ASME code. Flush welded patches shall be subjected to an appropriate nondestructive examination which shall be consistent with the original construction requirements. See Figure 9 for acceptable methods.

(b) In some situations it is necessary to weld a flush patch on a tube, such as when replacing tube sections and accessibility around the complete circumference of the tube is restricted, or when it is necessary to repair a small bulge. This is referred to as a window patch. Suggested methods for window patches are shown in Figure 10.

(2) LAPPED AND FILLET WELDED PATCHES. Lapped and fillet welded patches may be applied provided they are not exposed to radiant heat. Lapped and fillet welded patches may be applied on the pressure side of the sheet, provided the maximum diameter of the opening repaired is no larger than 8 inches and does not exceed 16 times the thickness of the plate. See Figure 11 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; r. and recr., Register, June, 1980, No. 294, eff. 7-1-80; am. (2), Register, February, 1982, No. 314, eff. 3-1-82.

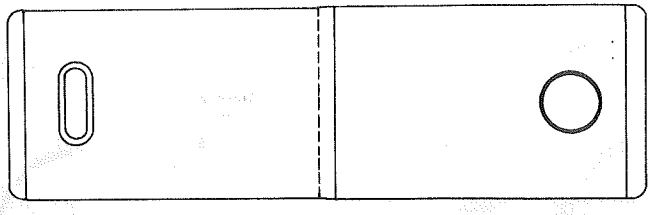
ILHR 42.16 Stays. Threaded stays may be replaced by welded-in stays provided that, in the judgment of the inspector, the plate adjacent to the staybold has not been materially weakened by wasting away. All requirements of the ASME code governing welded-in stays shall be met,

except that stress relieving other than thermal may be used as provided in s. ILHR 42.13 [42.14].

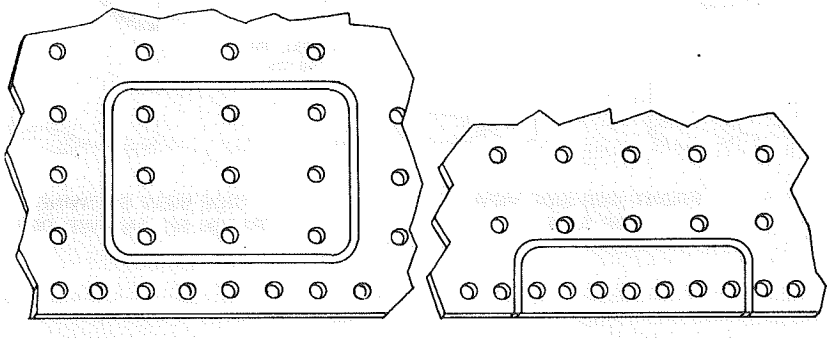
History: Cr. Register, April, 1961, No. 64, eff. 5-1-61; r. and recr., Register, June, 1980, No. 294, eff. 7-1-80.

ILHR 42.17 Additional acceptable repair methods. Repairs and repair methods not covered in this chapter may be used if acceptable to the inspector. Some additional methods are illustrated in Figures 12 and 13.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61; r. and recr., Register, June, 1980, No. 294, eff. 7-1-80.



FLUSH PATCHES IN UNSTAYED AREAS



FLUSH PATCHES IN STAYED AREAS

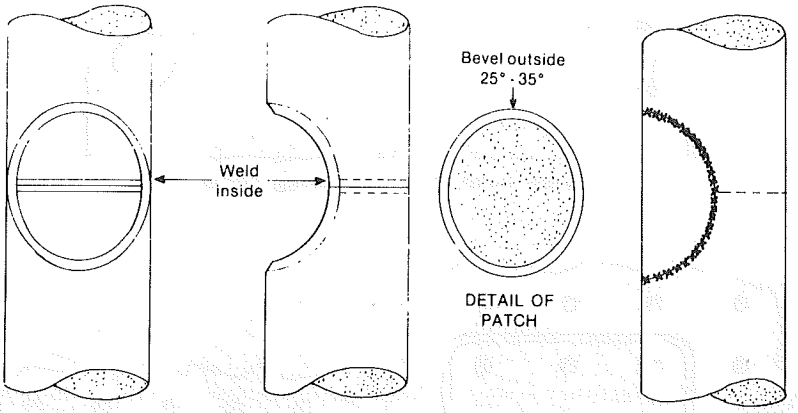
Before installing a flush patch, the defective metal should be removed until sound metal is reached. The patch should be rolled or pressed to the proper shape or curvature. The edges should align without overlap.

In stayed areas, the weld seams should come between staybolt rows or riveted seams.

Patches should be made from material that is at least equal in quality and thickness to the original material.

Patches may be of any shape or size. If the patch is rectangular, an adequate radius should be provided at the corners. Square corners should be avoided.

FIGURE 9 — FLUSH OR BUTT-WELDED PATCHES



It may be necessary to weld a flush patch on a tube, since in some situations, accessibility around the complete circumference of the tube is restricted. Listed below are suggested methods for making window patches:

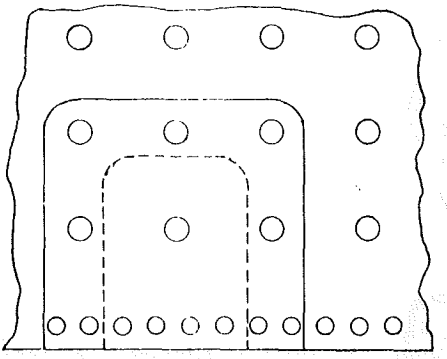
a. The patch should be made from tube material of the same type, diameter and thickness as the one being repaired.

b. Fitup of the patch is important to weld integrity. The root opening should be uniform around the patch.

c. The gas tungsten arc welding process should be used for the initial pass on the inside of the tube and for the initial pass joining the patch to the tube.

d. The balance of the weld may be completed by any appropriate welding process.

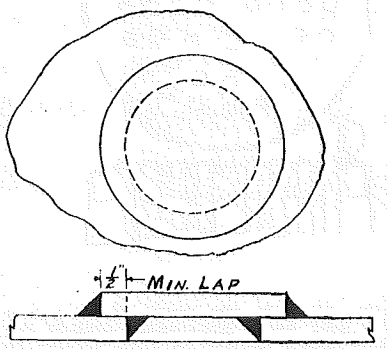
FIGURE 10 — TUBE WINDOW PATCHING METHOD



Patches shall be of material equal to the original in quality and thickness.

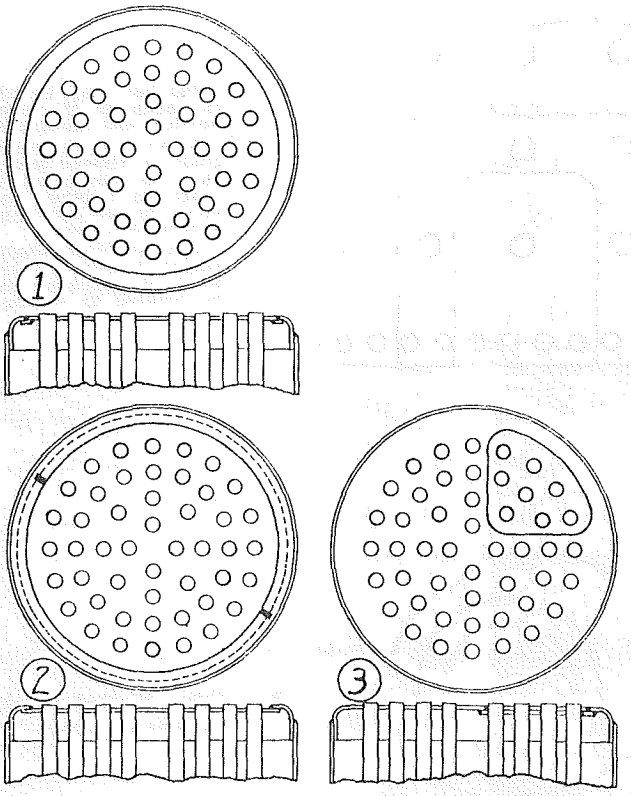
If area to be patched includes a riveted seam rivets shall be removed before patch is applied and new rivets driven before patch is welded at edges.

New staybolts shall be installed in patched area, the heads of staybolts shall not be covered by welding.



Lap Fillet Welded Patch in Unstayed Area

FIGURE 11--LAP-FILLET WELDED PATCHES



1. Flush Butt Welded Head

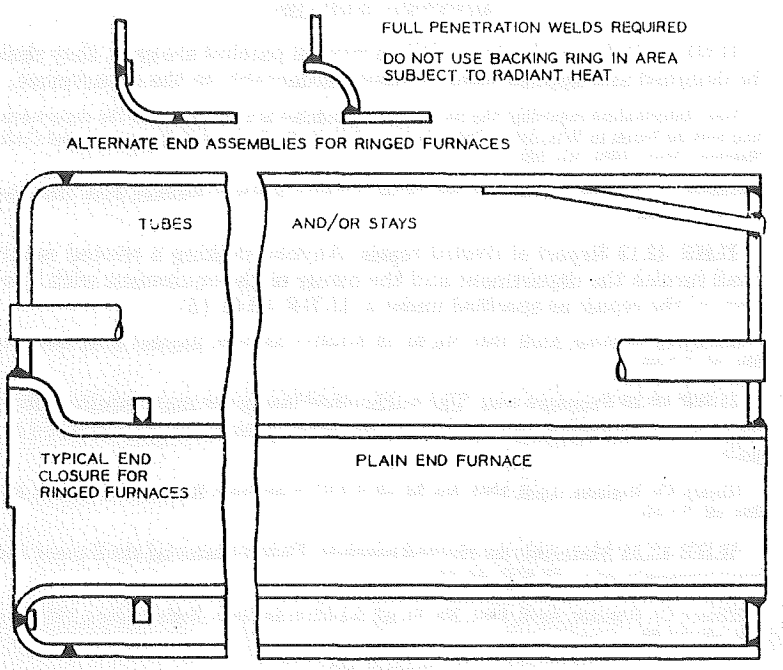
With this repair the old head is cut close to the point of tangency of the knuckle of the flange and the new head, previously drilled for tube holes and beveled for adequate welding groove is butt welded to flanged section of old head. Pack up ring, inserted in sections if necessary, shall be used to insure weld penetration for full head thickness.

2. Lapped and Fillet Welded Head

With this repair, the new head is lapped under the flange knuckle of old head, previously slotted as shown to admit new head, then fillet welded at edge.

3. Segmental or Pie-Shaped Butt Welded Patch

FIGURE 12--ACCEPTABLE REPAIRS FOR CORRODED OR WORN HEADS OF VERTICAL TUBE OR SIMILAR TYPE BOILERS



Longitudinal seam in furnace double butt-welded and thermally stress-relieved. For repair, final joint to each head may be stress-relieved by peening. Furnace may be welded into a riveted boiler by using adaptable end closures. Ringed furnace shall be thermally stress-relieved after longitudinal seam and rings have been applied.

FIGURE 13--SUGGESTED FURNACE RENEWAL

PART II

RIVETED REPAIRS

ILHR 42.18 Riveted patches. When riveted patches are used, they shall be designed and applied using methods acceptable to the department.

Note: Information regarding the use of riveted patches is available from the department and may be found in Wis. Adm. Code chapters Ind 41-42, Boiler and Pressure Vessel Code, Register, May, 1974, No. 221.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61; r. and recr. Register, June, 1980, No. 294, eff. 7-1-80.

ILHR 42.19 Report of riveted repair. Anyone making a riveted repair shall furnish the department and the owner of the equipment with a report of the repair as specified under s. ILHR 42.01 (5).

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61; r. and recr. Register, June, 1980, No. 294, eff. 7-1-80.

ILHR 42.20 Pressure test. The authorized inspector may require a pressure test, as specified in s. ILHR 42.02, after completion of a riveted repair.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61; r. and recr. Register, June, 1980, No. 294, eff. 7-1-80.

ILHR 42.21 Materials for riveted patches. Patch material shall meet the requirements of s. ILHR 42.10.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61; r. and recr. Register, June, 1980, No. 294, eff. 7-1-80.

PART III

RERATING OF A BOILER OR PRESSURE VESSEL

ILHR 42.22 Rerating of a boiler or pressure vessel. (1) Rerating of a boiler or pressure vessel by increasing the maximum allowable working pressure or temperature shall be considered an alteration and may be done only after the following requirements have been met to the satisfaction of the department:

(a) Revised calculations verifying the new service conditions shall be requested from the original manufacturer and shall be made available to the authorized inspection agency. Where such calculations cannot be obtained from this source, they may be prepared by a Wisconsin registered professional engineer and forwarded for review by the department.

(b) All reratings shall be established in accordance with the requirements of the code to which the boiler or pressure vessel was built, or by computation using the appropriate formulas in the latest edition of the ASME code if all essential details are known to definitely comply with the latest edition of the code (table 41.10-A).

(c) Current inspection records verify that the boiler or pressure vessel is satisfactory for the proposed service conditions.

(d) The boiler or pressure vessel rerating is acceptable to the authorized inspection agency responsible for the object.

(2) The requirements of s. ILHR 42.01 (2) (b), (c) and (d) shall be met and an alteration report shall be submitted in accordance with s. ILHR 42.01 (5).

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61; r. and recr. Register, June, 1980, No. 294, eff. 7-1-80.

PART IV

SECONDHAND VESSELS—PORTABLE BOILERS

ILHR 42.25 Application. Sections ILHR 42.25 through 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 s. ILHR 42.33).

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

ILHR 42.26 Code constructed vessels. Secondhand vessels which were constructed and stamped according to some edition of the ASME Boiler and Pressure Vessel Code or other recognized pressure vessel codes acceptable to the department may be installed and operated at or below the working pressure stamped on the vessel.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61; am., Register, May, 1974, No. 221, eff. 6-1-74; am., Register, June, 1980, No. 294, eff. 7-1-80.

ILHR 42.27 Existing vessels. Secondhand boilers which were constructed and installed in Wisconsin under the provisions of ss. ILHR 41.60 through 41.99 may be reinstalled if the working pressure is recalculated with a factor of safety of 6. Secondhand pressure vessels which do not meet the requirements of s. ILHR 42.26 may be reinstalled if the working pressure is recalculated with a factor of safety of 6, using ss. ILHR 41.63 through 41.65 and ss. ILHR 41.71 through 41.75 for such calculations.

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

ILHR 42.28 Vessels from out of state. Secondhand vessels from out of state shall meet the requirements of s. ILHR 42.26. A copy of the manufacturer's data report shall be furnished to the department for each vessel indicating that it was manufactured originally to the requirements of an earlier edition of the applicable ASME code. If a vessel has been repaired or altered since its fabrication, a copy of the manufacturer's data report, welded repair report or alteration report shall be furnished to the department.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61; am., Register, June, 1980, No. 294, eff. 7-1-80.

ILHR 42.29 Lap seam boilers. Second hand boilers which have lap seam construction and which are larger than 36 inches in diameter shall be limited to a maximum allowable working pressure of not more than 15 pounds per square inch.

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

ILHR 42.30 Prohibited boilers. The installation of secondhand boilers which have the longitudinal joint exposed to the intense heat of the furnace is prohibited.

Note: The locomotive or inside welt strap will not be considered as strengthening or changing the original type of boiler joint.

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

ILHR 42.31 Inspection and testing. (1) Every secondhand vessel shall be inspected and given a hydrostatic pressure test at one and one-half times the working pressure at its new point of installation location before it is placed in operation. The test shall be witnessed by an authorized inspector.

(2) When the department determines that a hydrostatic test at one and one-half times the working pressure is not possible or desirable, the department may accept alternate means to determine if the vessel is safe for its intended use.

Note: Where water is used in a hydrostatic test, the temperature of the water should not be less than 70° F and the maximum temperature during inspection should not exceed 120° F. If a test is conducted at 1½ times the maximum allowable working pressure (MAWP) and the owner specifies a temperature higher than 120° F, the pressure should be reduced to the MAWP and the temperature to 120° F for the close examination.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61; am. (1) (intro.), (2) and (3), Register, May, 1974, No. 221, eff. 6-1-74; r. and recr., Register, June, 1980, No. 294, eff. 7-1-80.

ILHR 42.32 Installation. Except for vessels exempted in s. ILHR 41.21, all secondhand vessels when reinstalled, shall comply with the ASME codes listed in s. ILHR 41.10 in regard to fittings, appliances, valves, connections, settings and supports.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61; am., Register, May, 1974, No. 221, eff. 6-1-74; am. Register, February, 1982, No. 314, eff. 3-1-82.

ILHR 42.33 Portable boilers. The owner or user of a portable boiler brought into this state for use, shall possess a certificate of operation issued by the department prior to use. The certificate will be issued only after the following requirements are met:

(1) The boiler is of ASME construction; and

(2) An internal or external inspection of the boiler has been made which is acceptable to the department.

History: Cr. Register, April, 1961, No. 64, eff. 5-1-61; r. and recr. Register, February, 1982, No. 314, eff. 3-1-82.

PART V
INSPECTION AND REPAIR OF PRESSURE VESSELS IN PETROLEUM REFINERIES

ILHR 42.35 Application. Sections ILHR 42.35 through 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.

ILHR 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 s. ILHR 42.40 or, in cases where the provisions of s. ILHR 42.39 (1) (c) apply, for an initial period during which corrosion rates are determined as specified in s. ILHR 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.

ILHR 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.

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; r. (2), Register, June, 1980, No. 294, eff. 7-1-80.

ILHR 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.

* 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 s. ILHR 41.50), all conditions should be recorded.

(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 sub. (2) (b).

(2) In addition to the progressive vessel record described in sub. (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.

ILHR 42.39 Determination of probable corrosion rate. (1) On new vessels and on vessels for which service conditions are being changed, 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 available, the probable corrosion rate as estimated from the inspector's knowledge and experience on vessels in similar service.

(c) If the probable corrosion rate cannot be determined by either of the above mentioned methods, thickness determinations shall be made after approximately 1,000 hours of service, or one normal run if longer than this; subsequent sets of thickness measurements shall be taken after additional similar intervals until the corrosion rate is established. If the probable corrosion rate is determined by this method, the corrosion data indicated by the first inspection may be used as a first approximation of the corrosion rate, but shall be excluded from all subsequent computations of the corrosion rate, since attack on the initial surfaces may not be indicative of subsequent attack on corroded surfaces.

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

ILHR 42.40 Maximum period between inspections. (1) When the contents of a vessel are known to be, or expected to be, corrosive, the maximum period between internal inspections shall not exceed ½ of the estimated remaining safe operating life of the veseel, or 5 years, whichever is less; except in cases where an adequate inspection history extending over a period of at least 5 years has established that the corrosion rate is reasonably uniform and predictable, the interval between the current inspection and the next subsequent one may be established as the projected full remaining safe operating life of the vessel, provided this projected period does not exceed one year.

(2) In cases where part or all of the vessel wall has a protective lining, the frequency of inspections for the portions of the vessel so protected shall be determined from a consideration of records of previous experi-

ence with the protection afforded by the lining during similar operations (and the corrosion allowance for the protected metal if there is any likelihood that the lining will fail), but the maximum period between internal inspections shall not exceed 5 years.

(3) When a vessel has 2 or more zones of considerable extent and the net discarding thicknesses, corrosion allowances, or corrosion rates for each differ so much that the foregoing provisions give significant differences in maximum periods between inspections for the respective zones (e.g., the upper and lower portions of some fractionating towers), the periods between inspections may be established individually for each zone on the basis of the conditions applicable thereto, instead of being established for the entire vessel on the basis of the zone which requires the more frequent internal inspection.

(4) The "net discarding thickness" for a vessel or zone, as referred to above, shall be understood to mean the large of the following:

(a) The net wall thickness, exclusive of any corrosion allowance, required for the safety valve setting and operating temperature for the service in which the vessel is being used, or

(b) The minimum practical thickness permitted by the provisions of s. ILHR 41.50.

(5) When the contents of a vessel are known to be non-corrosive, the vessel need not be inspected internally as long as it remains in the same service and provided all the following conditions are met:

(a) The non-corrosive character of the contents, including the effect of trace components, shall have been established by at least 5 years comparable service experience with the fluid which is being handled.

(b) No questionable condition is disclosed by the annual external examinations required by sub. (7).

(c) The operating temperature of the vessel contents does not exceed 500° F for ferrous metals, or 250° F for non-ferrous metals.

(d) The vessel is so installed that the contents are not subject to inadvertent contamination by corrosives.

(6) When the contents of a vessel are expected to be non-corrosive, but one or more of the conditions of sub. (5) is not met, the maximum period between inspections shall not exceed 5 years, or such shorter interval as may be deemed necessary if some kind of deterioration other than corrosion is anticipated or suspected.

(7) In addition, all vessels aboveground shall be given a visual external examination at least once every 12 months, preferably while in operation, to determine the readily apparent condition of the vessel, its supports, and exterior insulation, as well as the general alignment of the vessel on its supports, which might indicate external loadings affecting the vessel's condition.

(8) The safety and relief valve equipment shall be inspected and tested at intervals as necessary to maintain the equipment in a safe operating condition. The intervals between inspections should be determined by experience in the particular service concerned. Other pressure relieving

devices, such as rupture disks, shall be given a thorough examination at intervals determined on the same basis.

(9) The periods for inspection referred to in this section assume that the vessel is in continuous operation, interrupted only by normal shutdown intervals. If the vessel is out of service for an extended interval, the effect of such a non-operating period shall be considered in revising the date of the next inspection which was established and reported at the time of the previous inspection. If the vessel is out of service for a continuous period of one year or more, it shall be given an inspection before again being placed in service.

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

ILHR 42.41 Inspection for corrosion. (1) The minimum thickness and maximum corrosion rate for any part of the vessel shall be determined at each inspection specified in s. ILHR 42.40 by methods such as described in the following paragraphs:

(a) The depth of corrosion in vessels subjected to corrosion service may be determined by gaging from uncorroded surfaces within the vessel, when such surfaces are available and suitably located with respect to the area in question. These surfaces may be obtained by either of 2 methods:

1. Protecting the normal surface with welded corrosion-resistant strips or buttons which can be removed during inspection; or

2. By using such strips or buttons as reference levels from which to measure if the strips or buttons are fully corrosion-resistant and if accelerated corrosion does not occur adjacent to the strips or buttons.

(b) When corrosion-resistant strips or buttons cannot be used, it may be practical to drill small holes from the corrosion-susceptible surfaces, before corrosion starts, at suitable intervals to a depth equal to the metal thickness allowed for corrosion, and to plug these holes with protective material that can be readily removed to determine from time to time the loss in metal thickness as measured from the bottom of these holes.

(c) When the depth of corrosion cannot be readily determined otherwise, holes may be drilled through the portions of the wall where corrosion appears to be a maximum, and the thickness determined by taking thickness-gage measurements through these holes. If suitably located existing openings are available, such measurements may be taken through these openings.

(d) Any other suitable method (such as ultrasonic or gamma-ray instruments) that will not affect the safety of the vessel may be used provided it will assure minimum thickness determinations accurate within the following tolerances:

Wall Thickness, t	Permissible Tolerance
5/16 in. and less	0.10t
Over 5/16 in.	1/12 in., or 0.05t, whichever is greater.

(2) For a corroded area of considerable size in which the circumferential stresses govern, the least thicknesses along the most critical element of such area may be averaged over a length not exceeding:

(a) The lesser of ½ the vessel diameter, or 20 inches, in the case of vessels with inside diameters of 60 inches or less; or

(b) The lesser of ⅓ the vessel diameter, or 40 inches, in the case of vessels with inside diameters greater than 60 inches—except that if the area contains an opening, the distance within which thicknesses are averaged on either side of such opening shall not extend beyond the limits of reinforcement as referred to in s. ILHR 41.50. If, because of wind loads or other factors, the longitudinal stresses would be of importance, the least thicknesses in a similarly determined length of arc in the most critical plans perpendicular to the axis of the vessel also shall be averaged for computation of the longitudinal stresses. The thicknesses used for determining corrosion rates at the respective locations shall be the average thicknesses determined as aforesaid; and for the purposes of s. ILHR 42.48 "the actual thickness as determined by inspection" shall be understood to mean the most critical value of average thickness so determined.

(3) Widely scattered pits may be ignored provided their depth is not more than ½ the net thickness of the vessel wall (exclusive of corrosion allowance), the total area of the pits does not exceed 7 square inches within any 8-inch diameter circle, and the sum of their dimensions along any straight line within this circle does not exceed 2 inches.

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

ILHR 42.42 Correction of corrosion rate. If, upon measuring the wall thickness at any inspection, it is found that an inaccurate rate of corrosion has been assumed, the rate to be used for the next period shall be increased or may be decreased to conform with the actual rate found.

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

ILHR 42.43 Inspection for defects. (1) The parts of a vessel which should be inspected most carefully depend upon the type of vessel and the operating conditions to which it is subjected. The inspector should be familiar with the operating conditions of the vessel and with the causes and character of defects and deterioration that may result therefrom.

(2) Among the many ways of inspecting a vessel for defects, careful visual examination is by far the most important and the most universally applicable. Other means that may be very useful from time to time include magnetic-particle (for cracks and other elongated discontinuities in magnetic materials), fluorescent or dye penetrants (for disclosing porosity, pinholes, etc., which extend to the surface of the material and for outlining other surface manifestations, especially in non-magnetic materials), hammer testing, pressure testing, exploratory chipping, etc. All of these methods should be considered as auxiliary to careful visual examination. The extent to which one or more of them should be used in any given case can be determined only by the exercise of mature judgment based upon the details of circumstances encountered. Adequate surface preparation is frequently of paramount importance to proper visual examination and to the satisfactory application of any auxiliary procedure such as those mentioned above. The extent to which special surface preparation may be required is dependent upon the individual circumstances

involved, but may require wire brushing, sandblasting, chipping, or grinding, or a combination of these operations in addition to routine cleanings.

(3) If it is found that external or internal coverings, such as insulation, refractory protective linings, corrosion-resistant linings, etc., where they exist are in good condition and there is no reason to suspect any unsafe condition behind them, usually it is not necessary to remove them for inspection of the vessel. In such cases, however, it sometimes may be advisable to remove small portions of the coverings in order to investigate their condition and effectiveness and the condition of the metal back of them. Where operating deposits, such as coke, normally are permitted to remain on a vessel surface, it is particularly important to determined whether such deposits adequately protect the vessel surface from deterioration; this may require thorough removal of the deposit in selected critical areas for spot-check examination. Where vessels are equipped with removable internals, these internals need not be completely removed provided reasonable assurance exists that deterioration in regions rendered inaccessible by them is not occurring to an extent that might constitute a hazard or to an extent beyond that found in more readily accessible parts of the vessel.

(4) The items that normally shall be examined during an inspection, subject in each case to the provisions of sub. (3) and various suggestions concerning some of the things to be looked for, or procedures that may be used, are as follows:

(a) *Shells and heads.* Examine surfaces carefully for possible cracks, blisters, bulges, and other evidences of deterioration giving particular attention to the knuckle regions of the heads. If evidence of distortion is found, it may be advisable to make a detailed check of the actual contour against the design shape even though this may require removal of insulation or internal protective linings. On vessels with torispherical (dished) heads, if no record exists as to the crown radius and knuckle radius of the heads, these dimensions should be ascertained and recorded even though no evidence of distortion is observed.

(b) *Joints.* Examine inner and outer surfaces of welded joints carefully for possible cracks and for other defects such as may have been uncovered by the progress of corrosion. Magnetic-particle inspection is suggested as a useful means for doing this either throughout the lengths of the welds or as a supplement to visual inspection on selected lengths which may appear to need more than a visual inspection. Examine riveted joints inside and outside of the vessel for the condition of rivet heads, butt straps, and plates, and for the condition of the calked edges.

(c) *Manways, nozzles, and other openings.* Examine the surfaces of all manways, nozzles, and other openings carefully for distortion, cracks, and other defects giving particular attention to all welding or riveting used for attaching such parts and their reinforcements. If drawings are not available which show details of opening reinforcements and their attachments, take such measurements on these components as may be needed for computing the adequacy thereof. If any question exists as to the condition of any threaded connections, the threaded parts should be disassembled to permit a careful check of the number of threads that remain effective and in good condition. Examine accessible flange faces for distortion and for the condition of gasket seating surfaces.

(5) The inspection items given above are not presumed to be complete for every vessel, but include those features common to most vessels and in general those of greatest importance. Inspectors must supplement this list with any additional items necessary for the particular vessel or vessels involved.

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

ILHR 42.44 Check of dimensions. The vessels shall be examined for visible indication of distortion; if any such distortion is suspected or observed, the over-all dimensions of the vessels shall be checked to determine the extent and seriousness of the distortion.

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

ILHR 42.45 Pressure relief devices. The safety valves and other protective devices, such as rupture disks and vacuum valves, where used, should be checked to see that they are in proper condition. This inspection, in the case of valves, will normally include a check on their operation at the set pressure, a check that the proper spring is installed for the service, and an examination to determine that inlets, outlets, and discharge piping are free or corrosion products or other stoppage.

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

ILHR 42.46 Temperature measuring devices. Temperature measuring devices used for determining metal temperatures shall be checked for accuracy and general condition.

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

ILHR 42.47 Allowable operation based on inspection data. Defects or damage discovered during the inspection shall be repaired in accordance with ss. ILHR 42.50 through 42.63, or shall constitute a basis for reducing the allowable working pressure in accordance with s. ILHR 42.48, or, as a final resort, for retiring the vessel from service.

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

ILHR 42.48 Allowable working pressure. (1) The allowable working pressure for the continued use of a vessel may be established by the code to which the vessel was built or by computation using the appropriate formulas in the edition of the ASME code listed in s. ILHR 41.10 if all essential details (such as quality of materials and workmanship, knuckle radii of heads, reinforcement of openings, etc.) definitely are known to comply with the latter. In corrosive service the actual thickness as determined by inspection minus twice the estimated corrosion loss before the date of the next inspection shall be used, except as modified in s. ILHR 42.40 (1). Suitable allowance shall be made for the other loadings in accordance with s. ILHR 41.50.

(2) For vessels with riveted joints, in which the strength of one or more of the joints is a governing factor in establishing the maximum allowable working pressure, consideration shall be given to whether, and to what extent, corrosion will change the possible modes of failure through such joints. Also, even though no additional thickness may have originally been provided for corrosion allowance at such joints, credit may be taken where computations show this to be justified, for the corrosion allowance inherent in the joint design.

(3) The allowable working pressure of vessels with one or more openings, for which the closures are auxiliary equipment not part of the pressure vessel, shall be determined only after due consideration of any pressure limitations imposed by such auxiliary equipment.

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

ILHR 42.49 Pressure test. (1) Unless required by sub. (2), a pressure test normally need not be made as a part of a periodic inspection. However, one shall be made when unusual, hard-to-evaluate forms of deterioration possibly affecting the safety of the vessel are disclosed by inspection (and after certain repairs, see s. ILHR 42.63). When a pressure test is made for this purpose, it shall be conducted at a pressure determined in accordance with the provisions of s. ILHR 41.50.

(2) Any vessel that has not previously been given a hydrostatic test at a pressure of 1.50 times its maximum allowable pressure as referred to in s. ILHR 41.50, or a pneumatic test at a pressure of 1.10 times the maximum allowable pressure, shall be given a hydrostatic pressure test at the time of each inspection at a pressure not less than 1.50 times its design pressure, or a pneumatic test not less than 1.10 times the design pressure, suitable correction being made in either case for differences in temperature between design and test conditions. Vessels whose main joints are 100% radiographed are exempted from this requirement.

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

ILHR 42.50 Field repairs; general. No repairs, additions, or alterations shall be made until the proposed methods of execution have been considered and approved by the inspector. Other methods may be used if submitted to and approved by the department. All such work shall be of the highest quality of workmanship, and shall be executed in a manner and by practices complying with the applicable provisions of s. ILHR 41.50, and with code approved materials and under proper supervision. Complete records of all such work shall be made and filed.

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

ILHR 42.51 Defects in welded joints and plates. Repairs to cracks found in welded joints and to minor defects found in plates may be made, after preparing a U or V-shaped groove the full depth and length of the crack, by filling this groove with weld metal deposited in accordance with the requirements of s. ILHR 42.57, or by riveting a reinforcing plate which meets the requirements of s. ILHR 41.50 for a hole equal in diameter to the full length of the crack after chipping out or drilling the ends.

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

ILHR 42.52 Corrosion pits. Isolated corrosion pits may be filled with weld metal deposited in accordance with the requirements of s. ILHR 42.57. Such pits shall be cleaned to sound metal before welding.

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

ILHR 42.53 Thickness gage holes. (1) In corroded vessels subject to rapid stress fluctuations, the holes drilled through the vessel wall for measuring thickness in accordance with s. ILHR 42.41 shall be closed by

welding which complies with s. ILHR 42.57 and provides complete penetration and fusion for the full depth of the hole.

(2) For vessels in other service, these holes may be treated as unreinforced openings and may be closed by any method permitted under the rules of the ASME code.

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

ILHR 42.54 Corroded or distorted flange faces. (1) Corroded flange faces may be cleaned thoroughly and built up with weld metal deposited in accordance with the requirements of s. ILHR 42.57 and re-machined in place, if possible, to a thickness not less than that of the original flange or that required by calculations in accordance with the rules in s. ILHR 41.50. Corroded flanges may also be re-machined in place, without building up with weld metal, provided the metal removed in the process does not reduce the thickness of the flange below that calculated as above.

(2) Warped flanges which cannot be re-machined, or flanges which have become distorted because of excessive tightening of bolts, shall be replaced with new flanges which have at least the dimensions conforming to s. ILHR 41.50, welded on in accordance with the requirements of s. ILHR 42.57.

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

ILHR 42.55 Cracks at tapped openings. (1) It is not recommended to repair a crack at a tapped opening by chipping, welding, and re-tapping.

(2) Instead of making a repair as mentioned in sub. (1), a fully reinforced flanged nozzle may be installed, or if a tapped connection is required, it may be provided by welding in a heavy-wall, 3000# minimum threaded coupling by one of the methods permitted in s. ILHR 41.50.

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

ILHR 42.56 Inadequate bolting material. Defective bolting material shall be replaced with suitable material which meets the requirements of s. ILHR 41.50.

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

ILHR 42.57 Field welding. (1) Strength welding shall be done by qualified welders and shall meet all other requirements of s. ILHR 41.50.

(2) Preheating to not less than 300° F may be considered as an alternative to thermal stress relief for minor alterations or repairs of initially stress relieved vessels constructed of the P-1 carbon steels listed in s. ILHR 41.10 and for the P-3 alloy steels preheat sometimes can be considered as an alternative, especially when the operating temperature is high enough to assure reasonable ductility of the weldment during operation, and there is no excessive hazard during hydrostatic tests. Vessels constructed of other steels, which initially were required to be stress-relieved normally, shall be stress-relieved if alterations or repairs involving strength welding are performed. Any stress relieving shall be performed in accordance with s. ILHR 41.50. When preheat is used as an alternative for thermal stress relief as provided above, the stress relief factor may be continued.

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

ILHR 42.58 Applying patches to vessels by welding. (1) Patches to be welded to vessel walls shall be made of material equivalent to the material of the plate to be repaired. If a flush patch is to be installed in a vessel with welded longitudinal joints, a type of joint shall be used which has a joint factor (efficiency) as high as the original longitudinal joint. If a flush patch is to be installed in a seamless section, a double welded butt joint shall be made.

(2) If a lap patch is applied, welding shall be performed in the same manner as for a reinforcing plate around an opening, and the proportions of the patch shall be determined as outlined in s. ILHR 41.50. The application of patch plates to both the outside and inside of the vessel wall sometimes is preferred to a single lap plate. (Such double patch plates should be avoided in high temperature service; in hydrogen blistering service a weep hole should be provided in one of the patch plates.) Lap patches attached by welding should not be applied to wall thicknesses over ⅝ inch.

(3) If a welded patch is applied to a riveted vessel, the type of welded joint used shall have at least as high an efficiency as the riveted longitudinal joint.

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

ILHR 42.59 Riveting. All field riveting shall meet the requirements of s. ILHR 41.50.

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

ILHR 42.60 Applying patches to vessels by riveting. The application of a riveted patch shall be made in confomity with the rules given in s. ILHR 41.50 for reinforcing plates attached by riveting.

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

ILHR 42.61 New connections. (1) New connections may be installed on vessels provided the design, location, and method of attachment meet the construction requirements of s. ILHR 41.50.

(2) Welding shall conform to the requirements of s. ILHR 42.57 and riveting to the requirements of s. ILHR 42.59.

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

ILHR 42.62 Calking riveted vessels. Rriveted joints may be made tight either by mechancial calking or by metallic arc seal welding in accordance with s. ILHR 41.50 after carefully cleaning the seam and cleaning around the rivet heads.

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

ILHR 42.63 Pressure test after repairs. A vessel, which has had repairs or alterations, shall be given a pressure test in accordance with s. ILHR 42.49 (2), provided the inspector deems it necessary.

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

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