

BPVC

Section VIII

Division 1

Key Changes 2019 Edition



-
- U-2(g) Guidance when Rules are not contained in VIII-1 and UG-16, Appendix 46 Alternative Design Rules
 - U-4 Units Used in Equations, Appendices 33 and GG
 - UG-14 and Mandatory Appendix 2, 2-2(d) Parts Machined from Rod and Bar
 - UG-18 and UG-84(g)(6) Materials in Combination
 - UG-44 External Loads on Flanges
 - UG-84 Impact Test Requirements
 - UG-99(k) and UG-100 Pressure Tests Cladded Vessels
 - UG-116(b) Nameplate Marking

-
- Figure UW-3 Category C Joint
 - UW-11(a)(4) Full Radiography of butt joints in nozzles and communicating chambers
 - UW-27, UW-9(a), and UW-12(f) Acceptable Welding Procedures
 - UW-51 Radiographic Examination of Welded Joints
 - UW-54 Qualification of Nondestructive Examination Personnel
 - UCS-56(c) and UHA-32(c) Revised to address PWHT of welds between dissimilar metals to be consistent with the text of UW-40(d).

-
- UCS-66(c) and Figure UCS-66/66M Low Toughness Concerns for Carbon Steels
 - UCS-79(d) Relaxation of post forming heat treatment rules for thin wall pipe and tube after cold forming
 - UHX-4(h) New Rules for Openings near Tubesheets
 - Mandatory Appendix 2 Rules for Bolted Flange Connections with Ring Type Gaskets
 - Mandatory Appendix 10-13 Records Retention

Code Changes

Following have been added:
Code Case users can check the current status of any Code Case at <http://go.asme.org/BPVCCDatabase>

Code Case users can also view an index of the complete list of Boiler and Pressure Vessel Code Cases and Nuclear Code Cases at <http://go.asme.org/BPVCC>.



[This Photo](#) by Unknown Author is licensed under [CC BY](#)

Paragraph U-2(g) revised with rules to allow usage of ASME Section VIII, Div. 2 for design methods not provided in Section VIII, Div. 1 as well as other recognized Standards or Codes.

New Appendix 46 was created to incorporate Code Case 2695 into Section VIII, Div. 1 and provide a means for the designer to use the rules given in ASME Section VIII, Div. 2.

2019 Edition

Paragraph U-2(g)

This Division of Section VIII does not contain rules to cover all details of ~~design and~~ construction. Where complete details of **construction** are not given, ~~it is intended that the Manufacturer,~~ subject to the acceptance of the Authorized Inspector, shall provide **the appropriate details to be used** ~~of design and construction which will be as safe as those provided by the rules of this Division.~~

2019 Edition

Paragraph U-2(g)

(1) Where design rules do not exist in this Division, one of the following three methods shall be used:

(-a) Mandatory Appendix 46.

(-b) proof test in accordance with UG-101.

(-c) other recognized and generally accepted methods, such as those found in other ASME, EN, ISO, national, and industry standards or codes. This option shall provide details of design consistent with the allowable stress criteria provided in UG-23.

2019 Edition

Paragraph U-2(g)

(2) The provisions of this paragraph shall not be used to justify the use of materials, joining processes (fabrication), examination, inspection, testing, certification, and overpressure protection methods other than those allowed by this Division.

For Subparagraph (1) finite element programs Appendix 46 is applicable and VIII-2 Part 5 to be used

Subparagraph (2) makes it clear for which "construction" areas that U-2(g) rules are not applicable.

UG-16(a) DESIGN - GENERAL

Last sentence added:

As an alternative, the design rules of Mandatory Appendix 46 may be used.

MANDATORY APPENDIX 46 RULES FOR USE OF SECTION VIII, DIVISION 2

46-1 SCOPE

This Appendix is applicable when using Division 2 to establish the thickness and other design details of a component for a Section VIII, Division 1 pressure vessel.

(c) When using the rules of Division 2, F set of design loads and load case combinations 4.1.5.3 are not required except when necessary to meet the requirements of UG-22. When the design loads of Division 2, Table 4.1.2 are used,

Revised Tables U-3, UCS-56-11, and UCS-79-1 to address Mn+ Ni limits for weld consumables and PWHT limits for P-No. 1SE Group 1 pressure vessels.

- Updated year of acceptable edition for ASME B16.24, ASME B16.42, ASME B16.47,
- ASTM E4, and ASTM E691. Updated title of ASME 816.24. Added ASCE/SEI 7-16.
- Updated year of acceptable edition of ASME PCC-2 to 2018.

Revised U-4 to limit any material data published in VIII-1 or from Section II, Part D in Code calculations to the units listed in Table U-4-1.

Renumbered paragraphs in U-4;

Added paragraph (f) to U-4 addressing dimensions shown as decimals or fractions;

Corrected reference in Appendix GG to clarify that the term "equations" as used in Para. GG-1 is referring to equations used throughout the Division, and not any equations listed in App. GG.

Relocated Table " Standard Units For Use of Equations " in Appendix 33 to paragraph U-4, and deleted Appendix 33 containing this Table.

U-4 UNITS OF MEASUREMENT, APPENDICES 33 and GG

The revision was established as a result of a Section VIII, Division 1 Interpretation approved under Record 13-842:

Question: When performing calculations in accordance with the rules of Section VIII Division 1, may the maximum allowable stress value given by Section II Part D, either in U.S. Customary or SI units, be converted to a local customary unit for use in the Code calculation?

Reply: No.



[This Photo](#) by Unknown Author is licensed under [CC BY-SA](#)

U-4 UNITS OF MEASUREMENT, APPENDICES 33 and GG

This means when performing code calculations that require an allowable stress from Section II, Part D, then this calculation shall be carried out using either U.S. Customary or SI units as listed in Appendix 33 (now Table U-4-1).

It was never the intent to permit Code users to convert from either the US customary or SI allowable stress tables to derive a value in some of the local unit; if that was not the case, then there would have been no point in publishing allowable stresses and other material property data in SI units in the first place.

UG-14 and Mandatory Appendix 2, 2-2(d)

Parts Machined From Rod and Bar

Code Cases 2155-2 and 2156-3 are revised to require the 30% reduction of area only for Table UCS-23 materials.

The Code Case 2925, Use of Alternative Rules for Hollow Cylindrically Shaped Components Machined From Rod or Bar has been recently issued.

The three Code Cases have been incorporated in UG-14 and Appendix 2, 2-2(d) and both paragraphs have been reconciled.

Depending on the hot-worked diameter there are requirements for the direction of the axial length, mechanical tests and NDE.

UG-14 and Mandatory Appendix 2, 2-2(d)

Case 2156-3 Use of Rod and Bar for Hollow Cylindrical-Shaped Parts

Code Cases will remain available for use until annulled by the applicable Standards Committee.

Case 2156-1 Use of Rod and Bar for Hollow Cylindrical-Shaped Parts Larger Than NPS 4 Section VIII, Division 1

Inquiry: In addition to the pressure parts listed in UG-14, may rod and bar material be used for hollow cylindrical-shaped parts larger than NPS 4 constructed under Section VIII, Division 1?

Reply: It is the opinion of the Committee that, in addition to the pressure parts listed in UG-14, rod and bar material may be used for hollow cylindrical-shaped parts larger than NPS 4, such as shells and nozzles, but excluding flanges of all types except as permitted by Appendix 2, constructed under Section VIII, Division 1, provided the following additional requirements are met:

(a) The materials shall conform to one of the specifications given in Section II and shall be limited to those permitted in the applicable part of Subsection C.

(b) The longitudinal axis of the part shall be parallel to the longitudinal axis of the rod or bar.

(c) In addition to those required by the material specification, at least two transverse tensile test specimens shall be taken from each lot of rod or bar material having the same nominal cross section dimensions. The second

diameter

(as defined in the material specification)

and

lieu of the rules of

specimen shall be taken at 90 deg around the perimeter from the first specimen. The axis of the tensile specimen shall be located, as nearly as practicable, midway between the center thickness and the surface of the rod or bar. Both specimens shall meet the tensile and yield requirements of the material specification and the reduction of area shall be not less than 30%. For those materials for which the material specification requires a reduction of area value greater than 30%, the higher value must be met.

(d) Each rod or bar, before machining, shall be 100% ultrasonically examined perpendicular to the longitudinal axis by the straight beam technique in accordance with SA-388. The shell shall be unacceptable if:

(1) The examination results show one or more indications accompanied by loss of back reflection larger than 60% of the reference back reflection.

(2) The examination results show indications larger than 40% of the reference back reflection when accompanied by a 40% loss of back reflection.

(e) Before welding, the cut surfaces of the part adjacent to the weld shall be examined by magnetic particle or liquid penetrant methods in accordance with Appendix 6 or 8, respectively, of Section VIII, Division 1.

(f) This Case number shall be shown on the Manufacturer's Data Report.

mechanical property

, for Table UCS-23 materials,

UG-14 and Mandatory Appendix 2, 2-2(d)

Case 2155-2 Use of Rod and Bar for Heads

Code Cases will remain available for use until annulled by the applicable Standards Committee.

Case 2155 Use of Rod and Bar for Heads Section VIII, Division 1

Inquiry: In ~~addition to the pressure parts listed in~~ UG-14, may rod and bar material be used for heads of pressure vessels constructed under Section VIII, Division 1?

Reply: It is the opinion of the Committee that, in ~~addition to the pressure parts listed in~~ UG-14, rod and bar material may be used for heads of pressure vessels constructed under Section VIII, Division 1 provided the following additional requirements are met.

(a) The material shall conform to one of the specifications given in Section II and shall be limited to those permitted in the applicable part of Subsection C.

(b) Flat heads with welding hubs, and heads machined so that the axis of the finished head parallel to the axis of the vessel is parallel to the long axis of the rod or bar, shall:

(1) in addition to those required by the material specification, have at least two transverse tensile test specimens taken from each lot of rod or bar material having the same ~~nominal cross section dimensions~~. The second specimen shall be oriented at 90 deg around the perimeter

diameter

(as defined in the material specification)

and

lieu of the rules of

from the first specimen. The axis of the tensile specimen shall be located, as nearly as practicable, midway between the center thickness and the surface of the rod or bar. Both specimens shall meet the ~~tensile and yield~~ requirements of the material specification and the reduction of area shall be not less than 30%. ~~For those materials for which the material specification requires a reduction of area value greater than 30%, the higher value must be met.~~

(2) be ultrasonically examined by the straight beam technique in accordance with SA-388. The examinations shall be performed along the perimeter of the head and also in the axial direction. The head shall be unacceptable if:

(-a) the examination results show one or more indications accompanied by loss of back reflection larger than 60% of the reference back reflection;

(-b) The examination results show indications larger than 40% of the reference back reflection when accompanied by a 40% loss of back reflection.

(3) before welding, have the cut surfaces of the head adjacent to the weld examined by magnetic particle or liquid penetrant methods in accordance with Appendix 6 or 8, respectively, of Section VIII, Division 1.

(c) This Case number shall be shown on the Manufacturer's Data Report.

mechanical property

, for Table UCS-23 materials,

UG-18 and UG-84(g)(6)

MATERIALS IN COMBINATION

The parenthetical example given in the second paragraph of UG-18 was deleted because the guidance suggested for weld metal impact testing requirements is not universally applicable, depending on the metals being welded and the dilution of the weld metal by each of the base metals being joined. This means the suggested guidance is not sufficiently accurate to be retained.

Added new paragraph UG-84(g)(6), addressing requirements for toughness testing and acceptance criteria for weld metal and HAZ test specimens when qualifying a WPS for joining dissimilar metals where WPS qualification with toughness testing is required.

UG-44(b) External loads (forces and bending moments) may be evaluated for flanged joints with welding neck flanges

FLANGES AND PIPE FITTINGS

Incorporation of Code Case 2901 to add the method in PVP2013-97814 for calculating allowable external forces and moments on standard welding neck flanges.

External loads (forces and bending moments) may be evaluated for flanged joints with welding neck flanges chosen in accordance with

- ASME B16.5, Pipe Flanges and Flanged Fittings
- ASME B16.47, Large Diameter Steel Flanges, NPS 26 Through NPS 60

UG-44(b) External loads (forces and bending moments) may be evaluated for flanged joints with welding neck flanges

FLANGES AND PIPE FITTINGS

For evaluation the following requirements to be used:

- The vessel MAWP (corrected for the static pressure acting on the flange) at the design temperature cannot exceed the pressure-temperature rating of the flange
- The actual assembly bolt load (see Appendix S) shall comply with ASME PCC-1, Appendix O
- The bolt material shall have an allowable stress equal to or greater than SA-193 B8 Cl.2 at the specified bolt size and temperature

UG-44(b) External loads (forces and bending moments) may be evaluated for flanged joints with welding neck flanges

FLANGES AND PIPE FITTINGS

For evaluation the following requirements to be used:

- The combination of vessel MAWP (corrected for the static pressure acting on the flange) with external moment and external axial force shall satisfy the following equation (the units of the variables in this equation shall be consistent with the pressure rating)

$$16M_E + 4F_E G \leq \pi G^3 ((P_R - P_D) + F_M P_R)$$

Nomenclature and for the Moment Factor, F_M the Table UG-44.1 is shown in the paragraph

UG-84(g) Location, Orientation, Temperature, and Values of Weld Impact Tests

Table UG-84.6 was to specify an approximate thickness range where the notch in the prepared HAZ impact test specimens should fall, and not the complete specimen removal location. The words in the text of UG-84(g)(2) did not clearly express that intent and required revision. At the same time, the testing requirements needed further clarification.

UG-84(g)(2) Location, Orientation, Temperature, and Values of Weld Impact Tests

Revised the second sentence in UG-84(g)(2) to clarify the intend of the Code as follows:

The number of heat affected zone impact specimen sets to be removed, and ~~the location of their removal~~ the location of the centerline in the prepared test specimens, shall be as shown in Figure UG-84.5 and Table UG-84.6.

Added new last sentence

Where the material thickness permits, the axis of the notch may be inclined to allow the root of the notch to align parallel to the fusion line.

UG-84(g)(2) Location, Orientation, Temperature, and Values of Weld Impact Tests

Revised Table UG-84.6 - to clarify the intent of the code related to approximate location of the notch in the test specimens.

- There are only two thickness ranges remaining, $t \leq \text{in. (19 mm)}$ and $t > \frac{3}{4} \text{ in. (19 mm)}$
- The centerline of the specimen shall be located within $\frac{1}{4} t$ and $\frac{1}{2} t$ range.

UG-84(g)(2) Location, Orientation, Temperature, and Values of Weld Impact Tests

Revised Table UG-84.6 - to clarify the intent of the code related to approximate location of the notch in the test specimens.

Table UG-84.6
Required HAZ Impact Test Specimen Set Removal

Base Metal Thickness, t	Number of Specimen Sets and the Locations of Their Approximate Centerline	
	Single-Sided Weld	Two-Sided Weld
$t \leq \frac{3}{4}$ in. (19 mm)	One set, $\frac{1}{4}t$ to $\frac{1}{2}t$	One set, middle $\frac{1}{2}t$ [Note (1)]
$t > \frac{3}{4}$ in. (19 mm)	One set, $\frac{1}{4}t$ to $\frac{1}{2}t$	Two sets, $\frac{1}{4}t$ to $\frac{1}{2}t$ [Note (2)]

GENERAL NOTE: Testing shall be performed on sets of three impact test specimens as required by UG-84(c)(1). Each specimen shall be full size, or the largest subsize specimen that may be removed from the available material thickness. The specimen sets shall be removed at the indicated depth from the weld surface, as described in Notes (1) and (2).

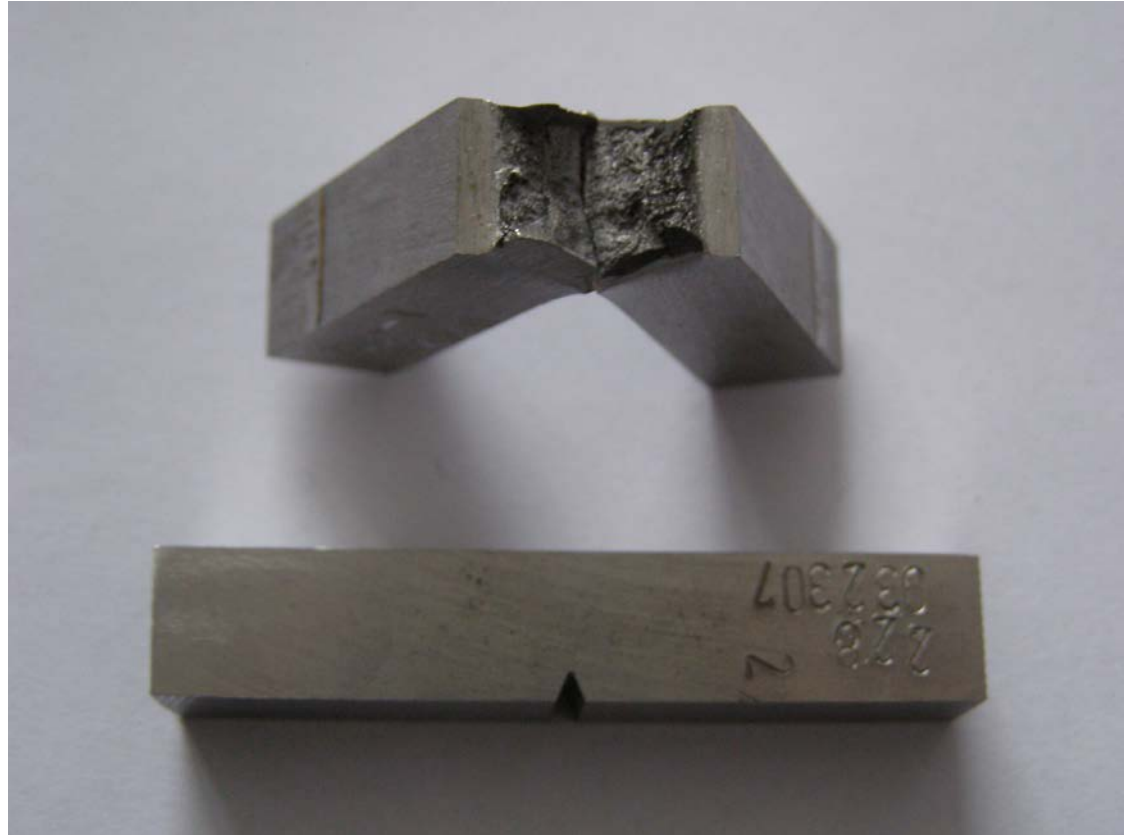
NOTES:

- (1) For two-sided welds in base metal thicknesses of $\frac{3}{4}$ in. (19 mm) or less, a single specimen set prepared with the centerline of the width of the notch falling within the middle $\frac{1}{2}t$ shall represent the HAZ of the welds applied to both surfaces.
- (2) For two-sided welds in base metal thicknesses greater than $\frac{3}{4}$ in. (19 mm), the specimen sets shall be prepared with the centerline of the width along the notch falling between $\frac{1}{4}t$ and $\frac{1}{2}t$ from each weld surface.

UG-84(h)(2)(-b) Impact Tests of Welding Procedure Qualifications

replaced UG-84(h)(2)(-b) with the following

...be in the same heat-treated condition and this heat-treated condition shall be noted on the PQR and WPS used for construction; and...



[This Photo](#) by Unknown Author is licensed under [CC BY-SA](#)

UG-84(i)(3)(-b) Number of Vessel Impact Test Plates Required

Added requirements for the number of HAZ test specimen sets in UG-84(i)(3)(-b); and revised the text in order to provide clarification.

~~For several vessels or parts of vessels, welded within any 3 month period at one location, the plate thickness of which does not vary by more than 1/4 in. (6 mm), or 25%, whichever is greater, and of the same specification and grade of material, a test plate shall be made for each 400 ft (120 m) of joints welded by the same procedure.~~ a minimum of one test plate shall be made for each welding procedure used for joints of Categories A and B provided that all of the following requirements are met:

UG-84(i)(3)(-b) Number of Vessel Impact Test Plates Required

Added requirements for the number of HAZ test specimen sets in UG-84(i)(3)(-b); and revised the text in order to provide clarification.

(-1) Welding is completed within any 3-month period at one location.

(-2) The cumulative length of all joints welded by each welding procedure does not exceed 400 ft (120 m).

(-3) Materials are of the same specification and grade.

UG-84(i)(3)(-b) Number of Vessel Impact Test Plates Required

Added requirements for the number of HAZ test specimen sets in UG-84(i)(3)(-b); and revised the text in order to provide clarification.

(-4) The plate thicknesses of the vessels or parts of vessels do not vary by more than 1/4 in. (6 mm) or 25%, whichever is greater.

(-5) The number of heat-affected-zone impact specimen sets to be removed and the locations of their removal shall be as shown in Figure UG-84.5 and Table UG-84.6 for the largest plate thickness in the range specified in (-4).

(-6) The additional requirements specified in (-a) shall be met.

UG-99(k) and UG-100

Pressure Test Requirements for vessels with metallic liners

- Revised UG-99(k)(2) and UG-100(e)(2) to clarify leak test requirements if a vessel is lined, are for **non-metallic liners**.
- Revised UG-99(k)(3) and UG-100(e)(3) to allow UCL-51 tightness test in lieu of pressure testing prior to installation of applied linings.
- Revised UCL-52 to clarify UG-99(k) is not required for vessels with integral clad or weld metal overlay cladding.

UG-116(b)

Construction Type Nameplate Marking Requirements

- Aligned nameplate markings between Divisions 1 and 2, by reducing the “construction type” markings that are mandatory on the nameplate for Section VIII.
- W, P, B, and RES have been eliminated as identified as not useful information to a repair organization, User or jurisdiction.
- Other markings found in certain parts of Subsection C, like UHT, WL, ULT and CS, have been added.

UG-116(b)

Construction Type Nameplate Marking Requirements

Type of Construction	Letter(s)
Tensile enhanced by heat treat (see UHT-115)	UHT
Layered (see ULW-115)	WL
Low temperature (see ULT-115)	ULT
Graphite (see UIG-116)	G
Cold stretch ed (see Mandatory Appendix 44, 44-7)	CS

UG-116(h)(1)

Revisions to Parts Fabrication Certificate Program (PRT)

Parts of vessels for which Partial Data Reports are required in UG-120(c) shall be marked by the parts Manufacturer, with a nameplate or stamping, with the following:

(-a) the official Certification Mark with, **as applicable**, the:

(-1) U or PRT Designator shown in Figure UG-116 sketch (a), above the word “PART”; **or**

(-2) PRT Designator shown in Figure UG-116 sketch (c)

UG-120(b)(3) added

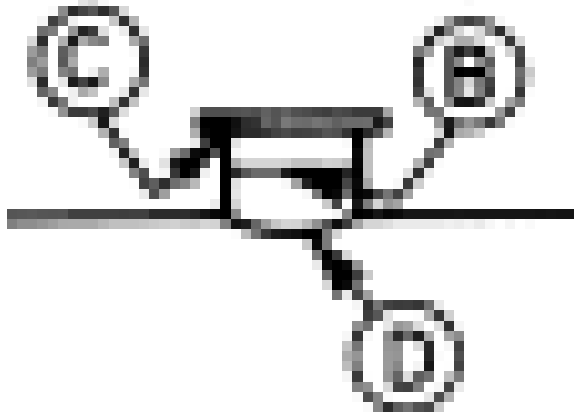
To advise the Manufacturer of the mandatory requirement to fill out form U-5 for fixed tubesheet exchangers.

For a fixed tubesheet heat exchanger, as defined in UHX-3.2, Form U-5 shall be filled out with the information required by UHX-19.3.2, signed by the Manufacturer and Inspector, and included with the Manufacturer's Data Report.

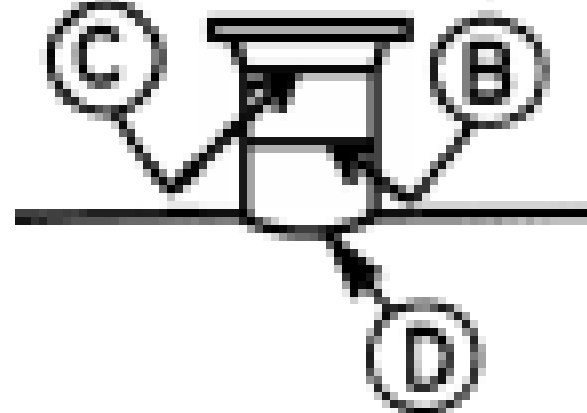
Figure UW-3

Revised Figure UW-3 by adding a sketch of weld neck flange with its weld category as C.

- 2017 Edition



- 2019 Edition



UW-27, UW-9(a), and UW-12(f)

Revised UW-27 to delete the list of welding processes and replace it with a single reference to Article 2 of Section IX for acceptable welding processes.

References to "pressure welding processes" in UW-9(a) and UW-12(f) are replaced with "permitted welding processes in UW-27(a) that include the application of pressure." Revised UW-9 and UW-12 to correct the paragraph references to the revised UW-27 paragraphs.

Added UW-27(e):

Welding processes accepted under Section IX Code Cases shall not be used unless those Code Cases are explicitly accepted by this Division.

UW-11(a)(4)

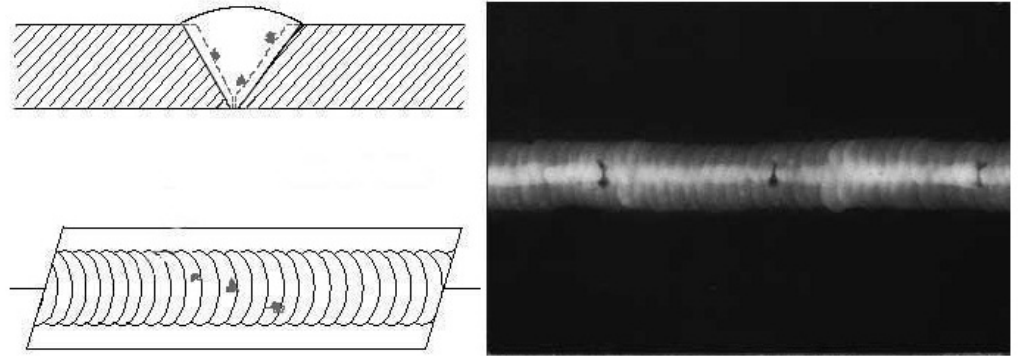
Full Radiography of butt joints in nozzles and communicating chambers

With removal of the second reference to Paragraph (2) this makes nozzle or communicating chamber radiography required only when the nozzle or communicating chamber itself exceeds the thickness requirements of UW-11(a)(2), or if the shell and/or head (so the entire vessel) is designed for lethal service or as an unfired steam boiler exceeding 50PSI.

UW-11(a)(4)

Full Radiography of butt joints in nozzles and communicating chambers

UW-11(a)(4) does allow for certain exemptions for Category B and C butt joints, due to thickness in these nozzles and communicating chambers, but not for Category A or D joints butt joints.



[This Photo](#) by Unknown Author is licensed under [CC BY-NC](#)

UG-116(b)(1), UW-9, UW-11(e), UW-12, Table UW-12, UW-15, and 2-4(b)

Deleted specific references to "arc or gas" welding.

The words of UW-12 used the phrase "arc or gas welding", which could imply that only arc or gas welding is acceptable.

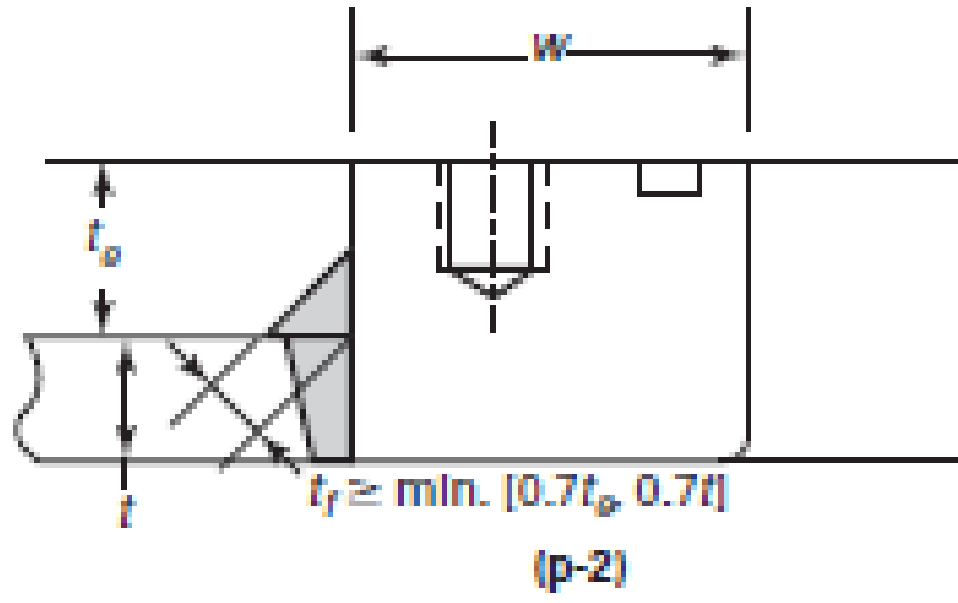
Other welding processes such as laser, electron beam, and friction stir are currently acceptable under Section IX Article II.

Similar phrases found throughout Section VIII, Division 1, were revised accordingly as well.

UW-16(d)(2) and Figure UW-16.1(p-2)

Added a new detail (p-2) to Figure UW-16.1

Added in UW-16(d)(2) the words "Studding-outlet-type flanges may also be attached by full-penetration welds as shown in Figure UW-16.1 sketch (p-2)".



UW-16(h)

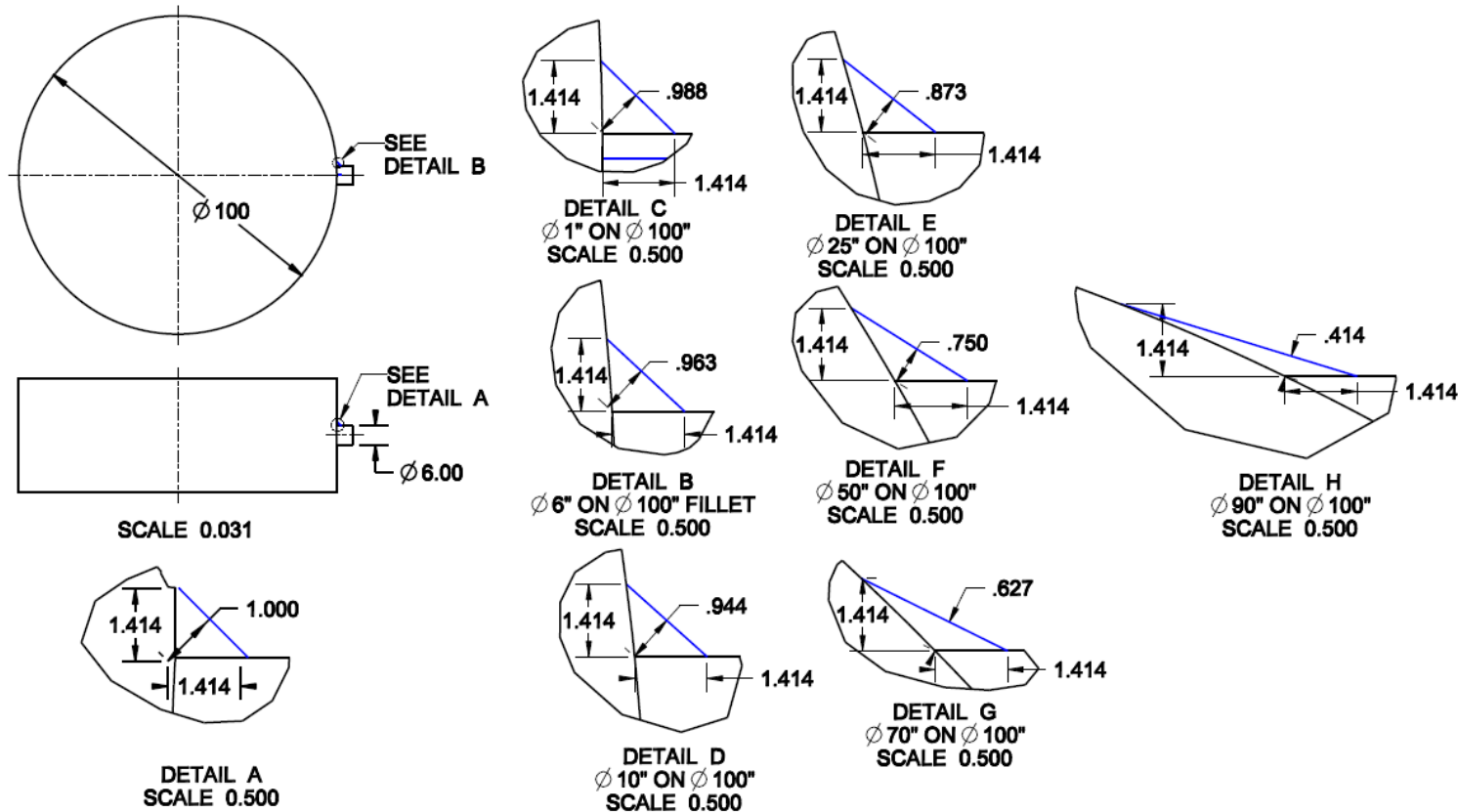
Added

UW-16(h) was added to provide clarification on what size fillet weld is required on the sides of a radial nozzle penetrating a cylinder where the nozzle diameter is close to the diameter of the cylinder.

(h) The minimum throat dimensions of fillet welds defined in UW-16.1 shall be maintained around the circumference of the attachment, except as provided below. ...

UW-16(h)

Minimum size of fillet weld required where the nozzle intersects the shell 90 degrees from the longitudinal axis of the cylinder

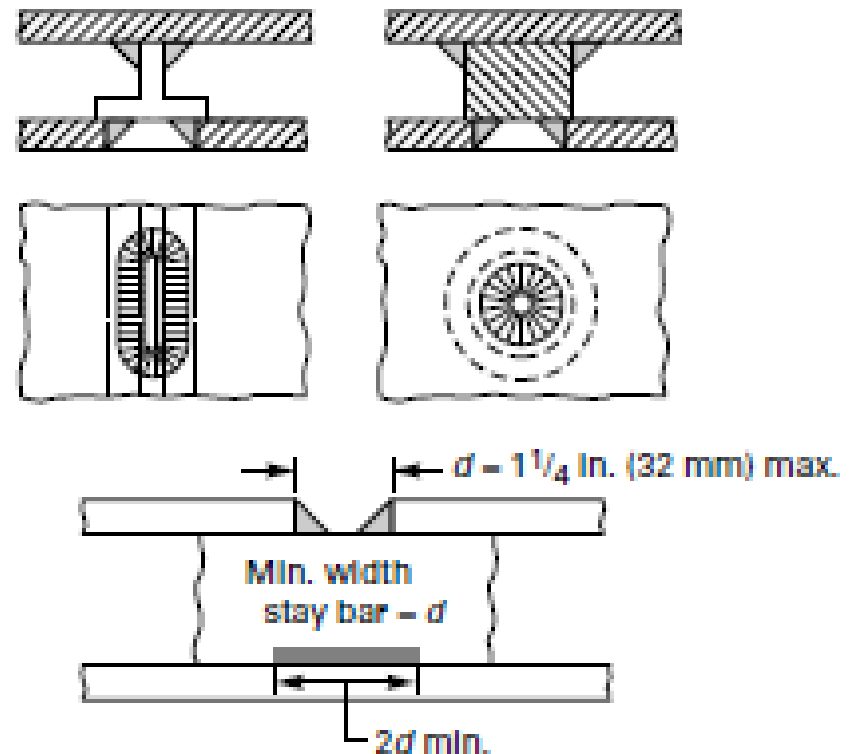


UW-19(c)(1)

Welded Stayed Construction

Revised to increase the applicable thickness limit from 3/16 in (5 mm) to 1/2 in (12 mm) when completely filling the hole with weld metal

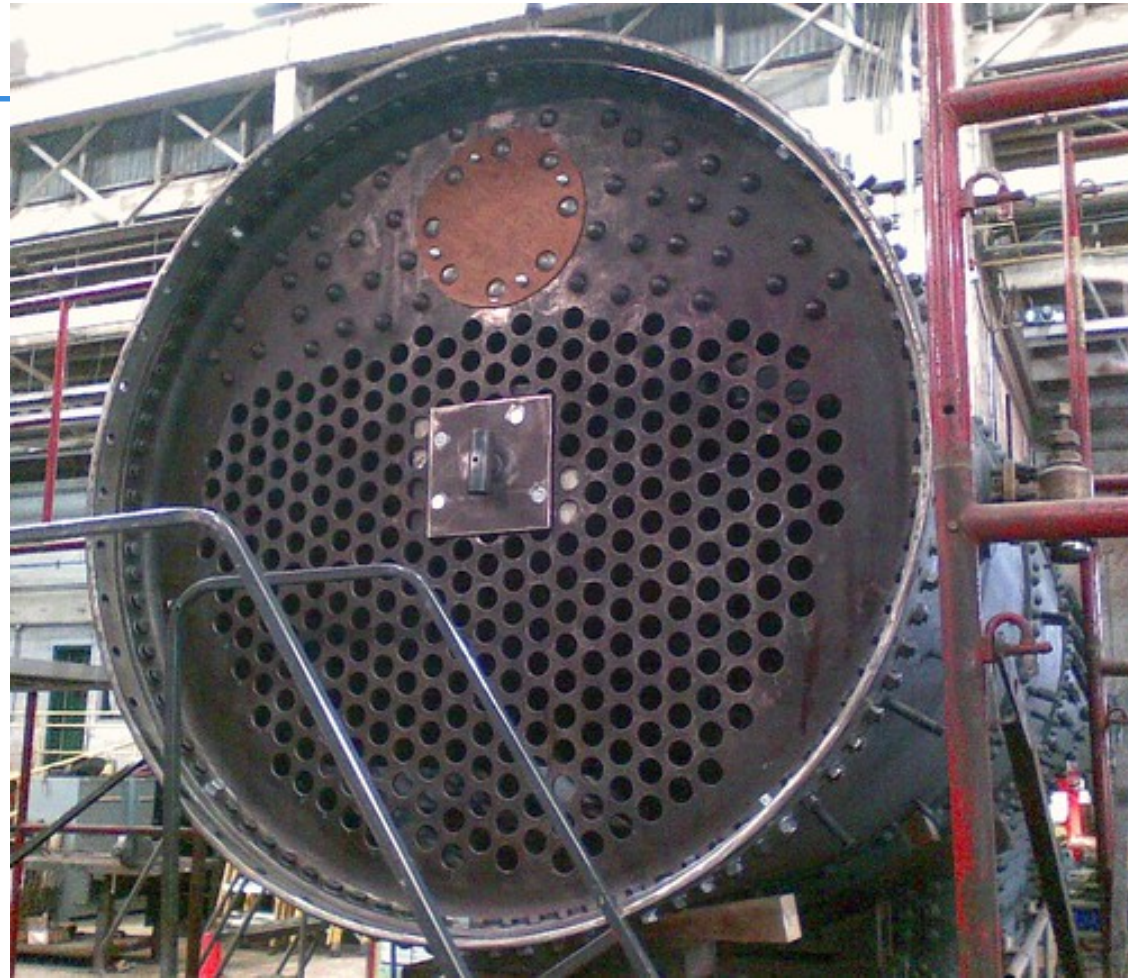
Use of Plug and Slot Welds for Staying Plates



UW-20.7(d)

Added

Clarification the tubesheet allowable stress to be used when the tubes are welded to a clad tubesheet is the allowable stress for the clad material and not the base material.



[This Photo](#) by Unknown Author is licensed under [CC BY-SA](#)

UW-50

Revised in its entirety

Now permits waiving the surface examination requirements imposed by UW-50 when performing pneumatic testing under the rules of UG-100 when qualifying conditions have been met



[This Photo](#) by Unknown Author is licensed under [CC BY-NC-ND](#)

UW-51 RADIOGRAPHIC EXAMINATION OF WELDED JOINTS

Revised UW-51(a)(2) by deleting the exception to written procedure requirements, replacing the term "penetrameter" with "image quality indicator", and striking the phrase "shall be the basis for final acceptance."

Revised UW-51(a)(4) to clarify that the permission to use UT in lieu of RT applies to welds in which the thinner of the members joined is 1/4 inch thick or greater.

UW-51 RADIOGRAPHIC EXAMINATION OF WELDED JOINTS

Revised UW-51(b) to simplify the wording, and delete the requirement for Inspector confirmation of the defect indication by ultrasonic examination.



UW-54 QUALIFICATION OF NONDESTRUCTIVE EXAMINATION PERSONNEL

Revised to resolve conflicts and confusion due to 2017 Edition revisions to Section V.

Removed reference to in Section V, Article 1, T-120(h), which is ANDE.

Also added reference to T-120(j) and T-120(k).

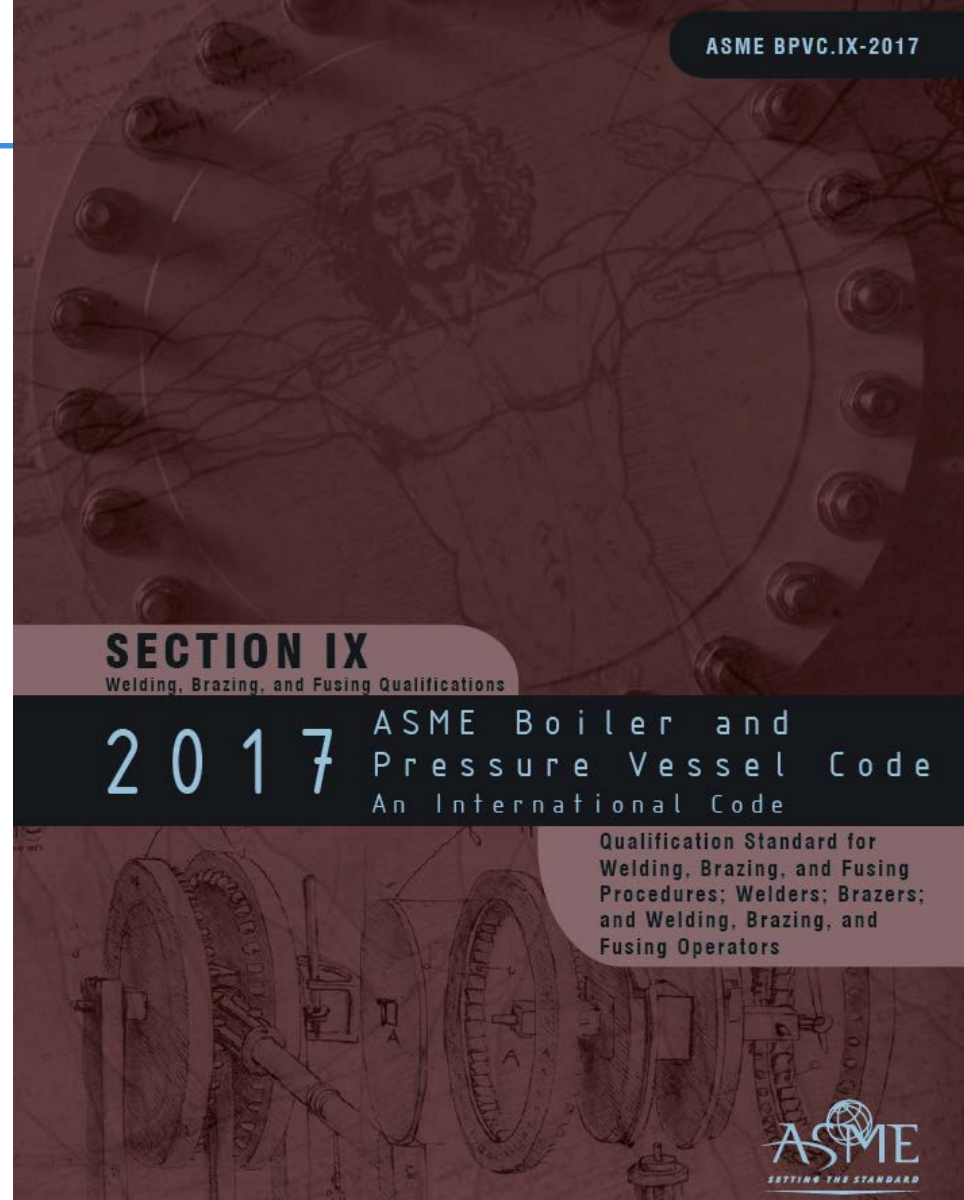
SNT-TC-1A (2016 Edition)

Please note the reference to T-120(e) is related to the Edition of SNT-TC-1A. In Section V, this has changed from 2006 in the 2017 Edition to 2016 in the 2019 Edition.

UCS-56(a)

Added Sentence

In UCS-56(a) added
"Section IX is the
governing document for
P-Numbers and Group
Numbers"



UCS-56(c) and UHA-32(c)

Revised to address PWHT of welds between dissimilar metals to be consistent with the text of UW-40(d).

2017 Edition:

When pressure parts of two different P-Number groups are joined by welding,

~~the postweld heat treatment shall be that specified in either of Tables UCS-56-1 through UCS-56-11 or Tables UHA-32-1 through UHA-32-7, with applicable notes, for the material requiring the higher postweld temperature.~~

When nonpressure parts are welded to pressure parts, the postweld heat treatment temperature of the pressure part shall control.

UCS-56(c) and UHA-32(c)

Revised to address PWHT of welds between dissimilar metals to be consistent with the text of UW-40(d).

Replaced in 2019 Edition:

When pressure parts of two different P-Number groups are joined by welding, engineering judgment shall be applied when selecting the postweld heat treatment temperature and holding time to produce material properties suitable for the intended service. Alternatives such as welding with buttering as described in Section IX, QW-283 may be considered.

When nonpressure parts are welded to pressure parts, the postweld heat treatment temperature of the pressure part shall control.

Table UCS-56-11, Note (3)

Addressed Mn+Ni limits for weld consumables and PWHT limits for P-No 15E Group 1 (Grade 91) material, Background:

The use of Grade 91 material is beginning to be recognized in VIII-1 as an alternative to 2-1/4 Cr vanadium modified material for high temperature high pressure hydroprocessing reactors, particularly as the design temperature approaches 482°C (900°F) or higher. At 482°C (900°F) the allowable stress of Grade 91 is approx. 30% higher than 2-1/4Cr V modified material. The design temperature would like to be raised up to 510°C (950°F). 2-1/4Cr V modified material can't be used at more than 482°C (900°F). However, as reactors are thicker wall [up to 350 mm (14 in.) thickness] with associated longer PWHT times, plus the requirement for hot tensile tests and impact testing, the need for high temperature strength and lower temperature toughness require weld consumables with higher Mn+Ni content to achieve these properties.

Table UCS-56-11, Note (3)

Addressed Mn+Ni limits for weld consumables and PWHT limits for P-No 15E Group 1 (Grade 91) material 2019 Edition:

For welds made with matching Grade 91 filler, the maximum holding temperature shall be determined as follows:

- (a) $\text{Ni} + \text{Mn} \leq 1.0\%$, max PWHT temperature shall be 1,455°F (790°C)
- (b) $1.0\% < \text{Ni} + \text{Mn} \leq 1.2\%$, max PWHT temp. shall be 1,435°F (780°C)
- (c) $\text{Ni} + \text{Mn} > 1.2\%$, max PWHT temperature shall be at least 20°F (10°C) below the lower critical transformation temperature (Ac1) as determined by measurement of that temperature for the specific heat of filler metal to be used in accordance with ASTM A1033

UCS-66(b)(1)(-c)

Deleted: “or (c)”

This revision is to delete the option of reducing MDMT of B16.5 and B16.47 standard flanges using shell stress ratio. Custom flanges whose MDMT is determined from UCS-66(a) still have the option of reducing MDMT by the stress ratio from the shell where the flange is attached.



UCS-66(c) and Figure UCS-66/66M

Low Toughness Concerns for Carbon Steels

After sifting through and considering the current available data provided to bring attention to these concerns, it became evident that the ratio of Mn/C is a strong indicator of the potential for low toughness for SA-106 pipe and SA-234 fittings.

The data also indicates that the toughness of SA-105 does not appear to be affected by the Mn/C ratio to any great degree. SA-105 toughness is more greatly affected by the applications of heat treatments after forging, and the amount of forming blows applied to the material during forming. It is possible to address the heat treatment requirements

UCS-66(c)

Revised UCS-66(c) - Added highlighted

Impact testing is not required for the ferritic steel flanges shown below when they are produced to fine-grain practice and supplied in the heat-treated condition (normalized, normalized and tempered, or quenched and tempered after forging) when used at design temperatures no colder than -20°F (-29°C) and no colder than 0°F (-18°C) when supplied in the as-forged condition.

- (1) ASME B16.5 flanges.
- (2) ASME B16.47 flanges.

UCS-66(c)

Revised UCS-66(c) - Added highlighted

(3) long weld neck flanges, defined as forged nozzles that meet the dimensional requirements of a flanged fitting given in ASME B16.5 but have a straight hub/neck.

The inside diameter of the neck shall not be less than the nominal size of the flange, and the outside diameter of the neck and any nozzle reinforcement shall not exceed the diameter of the hub as specified in ASME B16.5.

Figure UCS-66, Note (1)(c), Note (2)(a)

Revised UCS-66(c) - Added highlighted

Added Note (1)(c)

A/SA-105 forged flanges supplied in the as-forged condition

Added in Note (2)(a)

A/SA-105 forged flanges produced to fine grain practice and normalized, normalized and tempered, or quenched and tempered after forging

UCS-66(b)

Application of a stress ratio for bolts and nuts becomes problematic because the bolt pre-load applied to equipment under the scope of ASME VIII is often significantly greater than the allowable stress of these components, therefore always generating a stress ratio > 1 . Appendix S and ASME PCC-1 provide the basis behind the higher pre-loads.

- Modified UCS-66(b) to clarify that Figure UCS-66.1 is not permitted for bolts and nuts

Added: “Use of Figure UCS-66.1 is not permitted for bolts and nuts.”

- Deleted "(including bolts and nuts)" from UCS-66(b)(1)(-b)
- Deleted "(including bolts and nuts)" from UCS-66(i)(2)

Figure UCS-66/M Notes (2) and (4)

Revised

SA/GB-713 Grade Q345R has a better impact toughness than SA-516 Gr. 70.

Therefore it can justified that impact exemption curve can be reassigned to

- Curve B if not normalized
- Curve D if normalized

UCS-79(d) revised in its entirety

Relaxation of post forming heat treatment rules for thin wall pipe and tube after cold forming

The requirement of a 15 minute hold time for post forming heat treatment implied by UCS-79 would destroy thin tubing.



[This Photo](#) by Unknown Author is licensed under [CC BY-SA](#)

UCS-79(d) revised in its entirety

Relaxation of post forming heat treatment rules for thin wall pipe and tube after cold forming

The cold-formed areas of vessel shell sections, heads, and other pressure parts shall be heat treated in accordance with UCS-56 if the resulting extreme fiber elongation determined in accordance with Table UG-79-1 exceeds 5% from the supplied condition except that alternative heating and cooling rates and hold times may be applied to formed pipe and tube having a nominal thickness of 1/4 in. (6 mm) or less when the heat treatment method is demonstrated to achieve a thorough heating of the pipe or tube.

UCS-79(d) revised in its entirety

- Cold-formed and bent P-No. 1 pipe and tube material having a nominal thickness not greater than $\frac{3}{4}$ in. (19 mm) does not require post-forming heat treatment.
- For P-No. 1, Group Nos. 1 and 2 materials other than those addressed by (1), post-forming heat treatment is required when the extreme fiber elongation exceeds 40% or if the extreme fiber elongation exceeds 5% and any of the following conditions exist...
- Cold-formed or bent P-Nos. 3 through 5C pipe and tube materials having an outside diameter not greater than 4 $\frac{1}{2}$ in. (114 mm) and a nominal thickness not greater than $\frac{1}{2}$ in. (13 mm) do not require a post-forming heat treatment.

Table UNF-23.2

Added UNS C95820, UNS C70620 and UNS C71520

Revised "UNS No." entries for

SB-111,

SB-148,

SB-171,

SB-283,

SB-359,

SB-466,

SB-467,

SB-543,

SB-956

Table UHA-23

Added UNS S32003 and UNS S31254

Revised "UNS No." entries for
SA-240,
SA-789,
SA-790,

Table UHA-32-2

Added General Note (d)

Provided an exemption from PWHT for the following alloys:

UNS S40910,

UNS S40920,

UNS S40930,

UNS S40935,

UNS S40945,

UNS S40975,

UNS S40977,

UNS S43932,

UNS S43940.

UHA-51(d)(3)

Added "nominal material thickness" definition

The nominal thickness of plates and pipes as defined in Mandatory Appendix 3 shall be used for determining the nominal material thickness for toughness requirements. For other product forms, the nominal material thickness shall be determined as follows:



[This Photo](#) by Unknown Author is licensed under [CC BY-SA](#)

UHA-51(d)(3)

Added "nominal material thickness" definition

- castings: maximum thickness between two cast coincidental surfaces
- hollow cylindrical forgings: maximum radial thickness
- disk forgings: maximum thickness, including the length of an integral hub if a hub is present
- weld neck flanges: the larger of the thickness of the flange ring or the neck

UHX-4(h)

Added new rules for openings near tubesheets

Except as limited in (1) and (2) below, nozzles in cylindrical shells or cylindrical channels adjacent to integral tubesheets (see Figure UHX-4-1) may be located at any distance from the tubesheet (refer to UG-37 and Figure UG-40 for nomenclature not defined in this paragraph).

These requirements do not apply to nozzles in shells or channels having tubesheets that are calculated as simply supported (see UHX-12.6, UHX-13.9, and UHX-14.7).

UHX-4(h)

Added new rules for openings near tubesheets

- (1) For a circular nozzle with d greater than 30% of D , no part of d may be located within $1.8 (Dt)^{1/2}$ of the adjacent tubesheet face (see Figure UHX-4-1).
- (2) For a noncircular nozzle, $d_{\max}$ (major axis) is defined as the maximum diameter of d , and $d_{\min}$ is defined as the minimum diameter of d .
- (-a) For a noncircular nozzle having its major axis not parallel to the tubesheet face and $d_{\max}/D > 30\%$, d is limited to the distance specified in (1).

UHX-4(h)

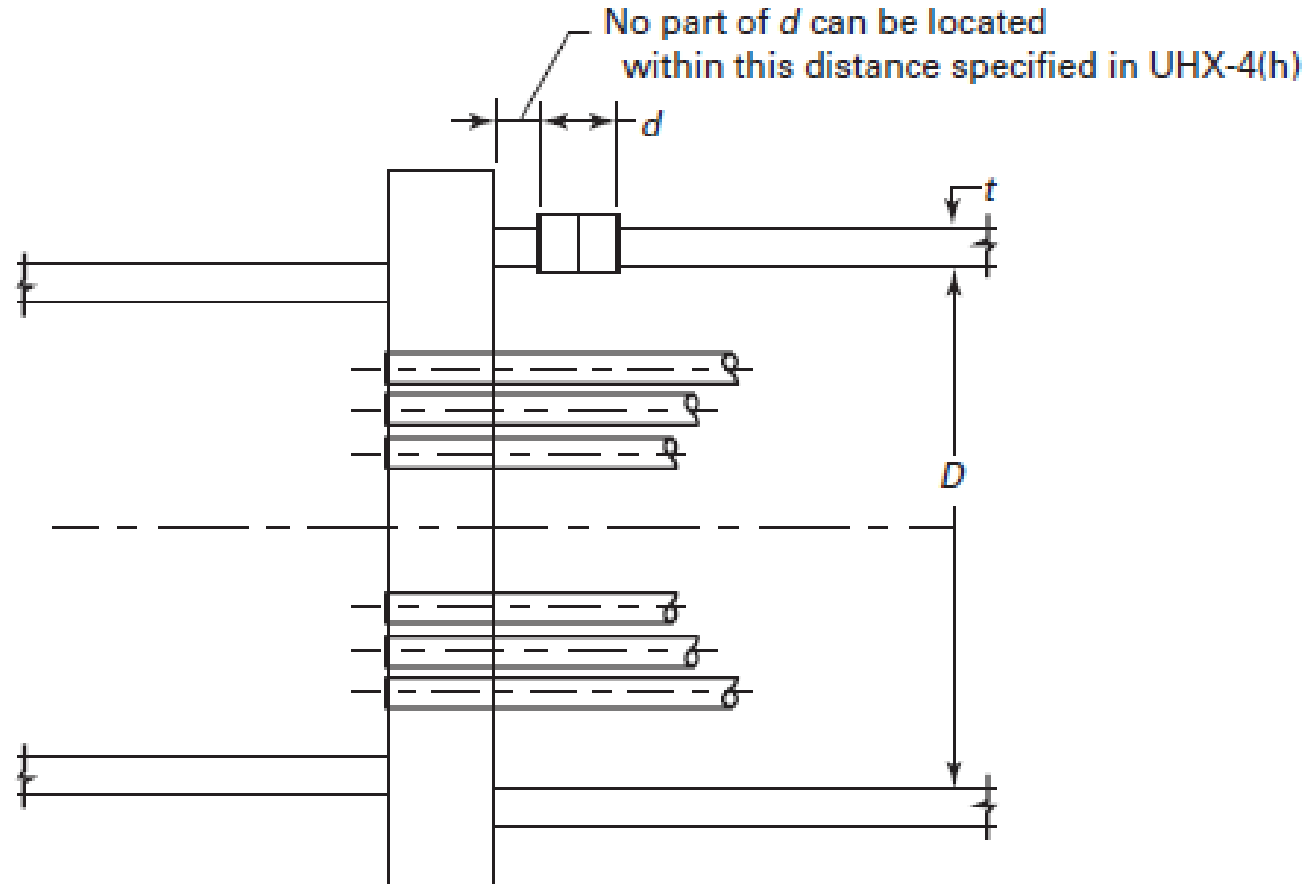
Added new rules for openings near tubesheets

(-b) For a noncircular nozzle having its major axis parallel to the tubesheet face and $d_{\max}/D > 30\%$, no part of d may be within $1.8(Dt)^{1/2} + (d_{\max} - d_{\min})/2$ of the adjacent tubesheet face.

(3) Nozzles subject to the limitations in (1) or (2) above may have their required reinforcement (see UG-37) located within $1.8(Dt)^{1/2}$ of the adjacent tubesheet face.

Figure UHX-4-1

Added Figure UHX-4-1 Nozzles Adjacent to Tubesheets



UHX-10(d) and Figure UHX-10(c)

Added in UHX-10(d)

If a hemispherical head is attached to the hub of a tubesheet, the hub may be considered part of the hemispherical head and not require an intervening cylinder, provided the hub complies with one of the following conditions:

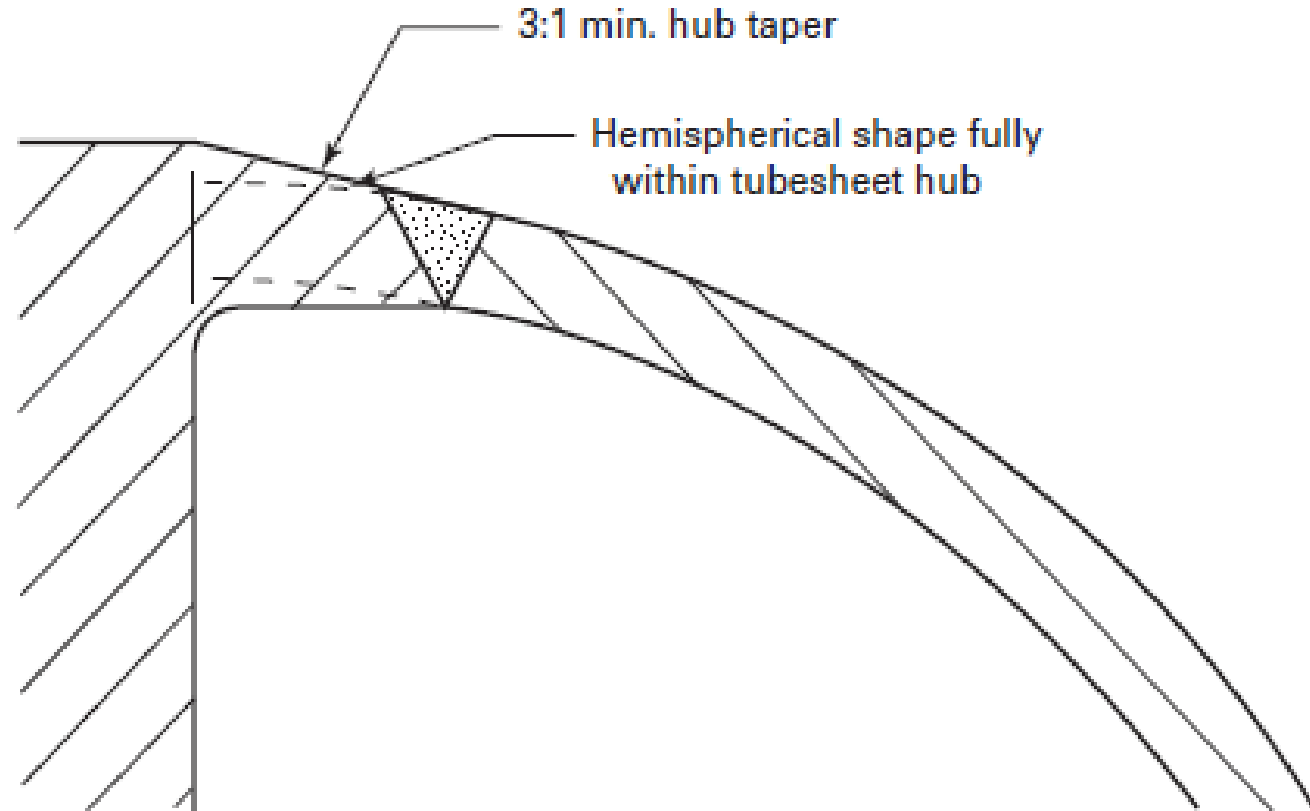
- (1) It is shaped as a continuation of the head in accordance with Figure UHX-10, sketch (b).
- (2) It meets the requirements of Figure UHX-10, sketch (c).

For both cases, the tangent line of the head is coincident with the adjacent face of the tubesheet.

UHX-10(d) and Figure UHX-10(c)

Added Figure UHX-10(c)
& Note(3)

(c) Hemispherical
Channel With Tubesheet
Hub Thicker Than
Channel



NOTES: (3) These rules also apply to channels integral with tubesheets having extensions.

UHX-12.5.9, UHX-13.5.8, and UHX-14.5.8

Revised allowable shear to include the yield limit as well

Changed allowable shear for all Tubesheet types
from $0.8S$
to $\min(0.8S, 0.533S_y)$.

The reason for this is that other items are in the works to provide stress limits for the test condition. This would keep the test condition from governing the design for cases where the shear went all the way to the 0.54 yield limit.

UIG-34(b)

Revised calculation procedure for tubesheets to incorporate the necessary information into part UIG, as well as to make necessary improvements to the procedure itself.

It was determined that some critical elements in the design of tubesheets were not yet considered.

The intention was incorporating all of the formulas, design considerations, and nomenclature that had previously been referenced from part UHX.

Very little has actually changed. Existing UIG rules simply state slight modifications to the design procedure laid out in UHX-13, the revision is just a copy of UHX-13 with these modifications incorporated.

MANDATORY APPENDIX 2

RULES FOR BOLTED FLANGE CONNECTIONS WITH RING TYPE GASKETS

Paragraph 2-2(b): The "flange section thickness" was revised to the thickness used in the flange design equations, "t".

Paragraph 2-2(d): Incorporated the (revised) Code Cases 2155-2 and 2156-3 and reconciled UG-14 and Appendix 2

Paragraph 2-3: Replaced W with W_{m1} in the definition of gasket load H_G

Paragraph 2-9(d): Added to clarify that flange rigidity rules are not required for split loose flanges.

MANDATORY APPENDIX 10-13

QUALITY CONTROL SYSTEM - RECORDS RETENTION

Subparagraph (b)(8)
revised: RT and UT to
NDE interpretation
reports

Subparagraphs (b)(14)
revised: hydrostatic to
pressure test records



[This Photo](#) by Unknown Author is licensed under [CC BY-NC-ND](#)