

**ASME INTRODUCTION
&
INSPECTION OF PRESSURE VESSEL**
(ASME Section VIII Div. 1 , Ed. 2015)

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CODE INTRODUCTION

- ❑ ASME was founded in 1880 in response to numerous steam boiler pressure vessel failures.
- ❑ First performance test code of Steam Boilers trail was conduct in 1884.
- ❑ First revision of an ASME standard was made in 1900 .
- ❑ ASME has over 140,000 members in 158 countries worldwide .
- ❑ It produces approximately 600 codes and standards covering many technical areas.

ASME Founders



Henry Rossiter Worthington



Alexander Lyman Holley



John Edson Sweet

ASME BPVC CODES



- | | |
|---|---------------------|
| <input type="checkbox"/> ASME Section I | – Power Boilers |
| <input type="checkbox"/> ASME Section II Part A | |
| ASME Section II Part B | – Materials |
| ASME Section II Part C | |
| ASME Section II Part D | |
| <input type="checkbox"/> ASME Section III | – Nuclear Codes |
| <input type="checkbox"/> ASME Section IV | – Heating Boilers |
| <input type="checkbox"/> ASME Section V | – NDE |
| <input type="checkbox"/> ASME Section VIII Div. 1 | |
| ASME Section VIII Div. 2 | – Pressure Vessel |
| ASME Section VIII Div. 3 | |
| <input type="checkbox"/> ASME Section IX | – Welding & Brazing |
| <input type="checkbox"/> ASME B31.3 | – Process Piping |
| <input type="checkbox"/> ASME B31.1 | – Power Piping |

ASME BPVC Timeline

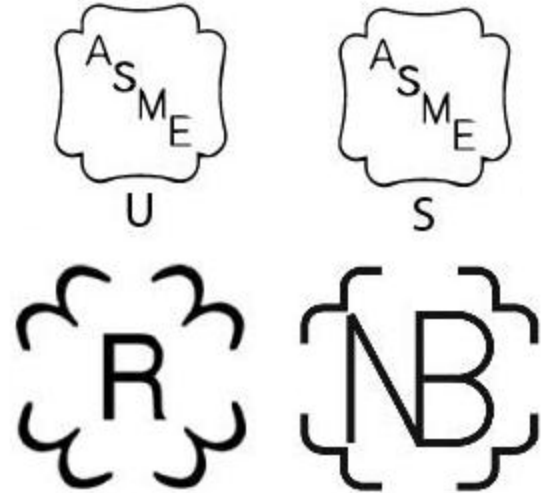


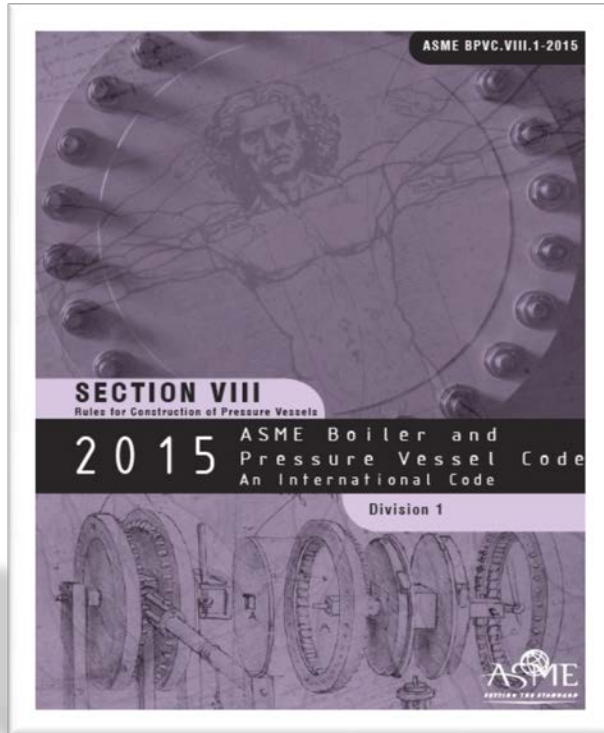
- ❑ 1911 – ASME set up the B&PV Committee – to formulate std rules for construction of boilers and pressure vessel
- ❑ 1915 – First Code issued – ASME 1 – Power Boilers
- ❑ 1923 – Heating Boilers – Section IV
- ❑ 1924 – Materials – Section II
- ❑ 1925 – Pressure Vessel – Section VIII Div. 1
- ❑ 1941 – Welding & Brazing – Section IX
- ❑ 1963 – Nuclear Codes – Section III
- ❑ 1968 – Pressure Vessel – Section VIII Div. 2
- ❑ 1971 – NDE – Section V
- ❑ 1997 – Pressure Vessel – Section VIII Div. 3

ASME and National Board Stamps



- S – Steam boilers
- A – Assembly only
- U – Pressure vessels
- U2 – Pressure vessels
- U3 – Pressure vessels
- PP – Power piping (B31.1)
- R – Repair
- NB – National Board





ASME VIII Div. 1 INSPECTION REQUIREMENTS

It provides requirements applicable to the design, fabrication, inspection, testing, and certification of pressure vessels operating at either internal or external pressures.

This code was established in 1925 (Sec. VIII, Div.1)

ASME Section Div. 1

Operating Pressure: 15 (psi) to 3,000 (psi)

ASME Section Div. 2

Operating Pressure: 3,000 (psi) to 10,000 (psi)

Its requirements are more rigorous than in Division 1

ASME Section Div. 3

Operating Pressure: above 10,000 (psi)

It does not establish maximum pressure limits

Its requirements are more rigorous than in Division 1 and 2

Forward Introduction:

U-1, U-2, U-3, U-4

Subsection A:

UG – General Requirements

Subsection B: (Methods of Fabrication)

UW – Welded pressure vessels

UF – Forged pressure vessels

UB – Brazed pressure vessels

Subsection C: (Classes of Material - Special Constructions)

Materials:

UCS – Carbon and Low Alloy Steel

UNF – Non ferrous Materials

UHA – High Alloy Steel

- UCI – Cast Iron
- UCL – Cladding and Lining
- UCD – Cast Ductile Iron
- UHT – Ferritic Steels with Heat Treatment
- ULW – Layered Constructions
- ULT – Low Temperature Service
- UHX – Shell and Tube Heat Exchanger

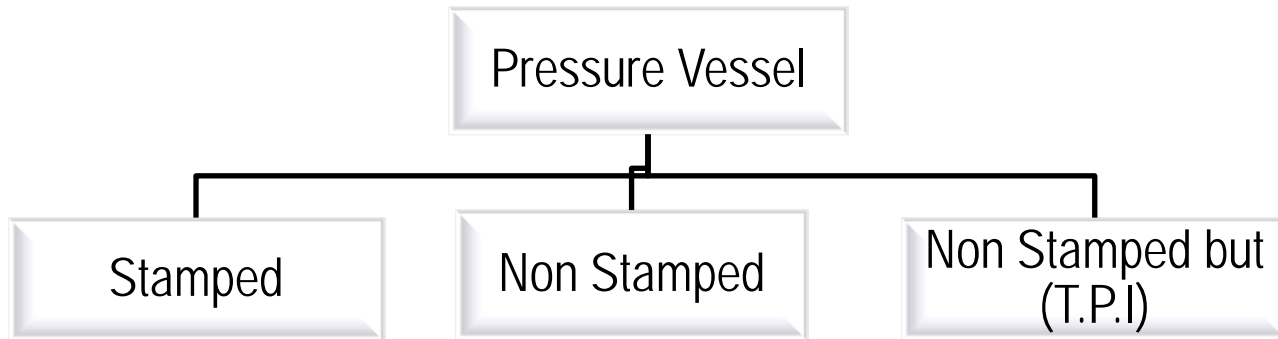
Subsection D:

Mandatory and Non mandatory Appendices Index

ASME Code Key Words:

- | | |
|-----------|--|
| Shall: | mandatory rules |
| May not: | prohibition |
| may can: | Recommendations/Exemptions from prohibitions |
| shall be: | Recommendations |

INSPECTION REQUIREMENTS



1. MATERIALS
2. FABRICATION
3. WELDING
4. NDE
5. PWHT (Supplementary)
6. HYDRO TEST
7. NAME PLATE

1- MATERIALS

- Examination of all materials before fabrication to make certain they have the required thickness, to detect defects [UG-93(d)], to make certain the materials are permitted by this Division (UG-4), and that traceability (UG-77) to the material identification(UG-93) has been maintained.
- Identification for all material used in the fabrication of the vessel or part (UG-93); E.g. Plate
 - Correct Material (As per Purchase Order/specs)
 - Visual Inspection for cracks specifically for impact tested material
 - Markings original/ transferred
 - Securing Partial Data Reports [UG-120(c)] (If part is ASME stamped)
- Check MTR according to ASME Section II Part A

1- MATERIALS

- Documentation of impact tests when such tests are required (UF-5, UCS-66, UHA-51, UHT-6, and ULT-5)
- Check Impact energy according to UG-84 (For C.S) and Lateral Expansion according to UHA-51 (For S.S and Duplex)
- Concurrence of the Inspector prior to any base metal repairs (UG-78 and UF-37)
- Documentation and Review of NDE results e.g. Lamination or Ultrasonic Testing e.t.c (If Required) according to specs.
- NACE Requirement (If Required)

2- FABRICATION

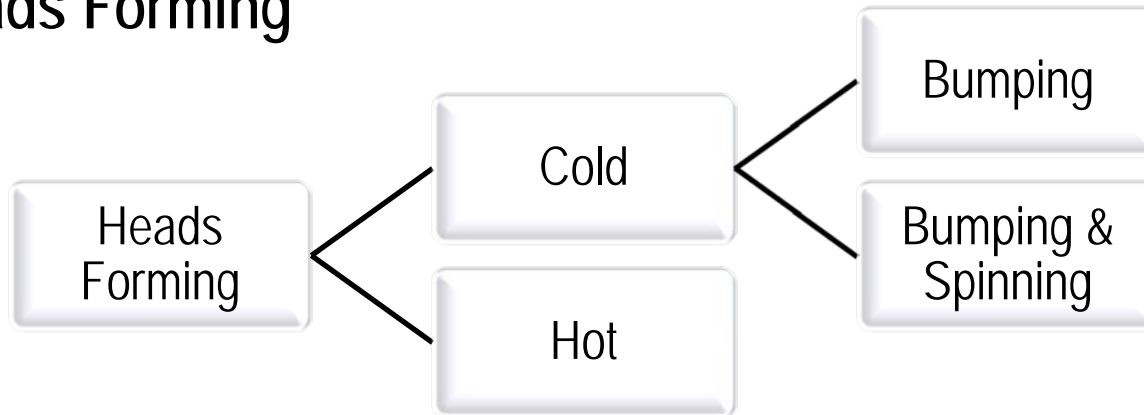
Heads and Shells Forming according to **UG-79**

- ❑ **UG-79 (a)** Limits are provided on cold working of all carbon and low alloy steels, nonferrous alloys, high alloy steels, and ferritic steels with tensile properties enhanced by heat treatment [**UCS-79(d)**, **UHA-44(a)**, **UNF-79(a)**, and **UHT-79(a)(1)**].
- ❑ **UG-79 (b)** If the plates are to be rolled, the adjoining edges of longitudinal joints of cylindrical vessels shall first be shaped to the proper curvature by preliminary rolling to avoid having objectionable flat spots along the completed joints.

INSPECTION REQUIREMENTS



2-1(a) Heads Forming



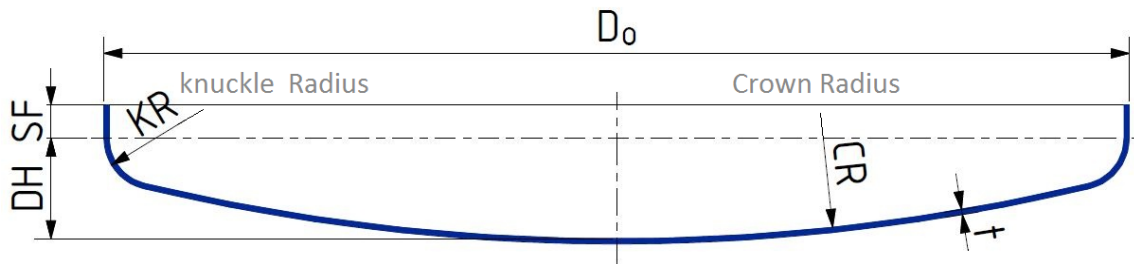
Bumping



Spinning

2-1(b) Heads Forming Inspection UG-81(a)

The inner surface of an ellipsoidal head shall not deviate outside of the specified shape by more than **1-1/4%** of Inside Diameter nor inside the specified shape by more than **5/8%** of Inside Diameter.



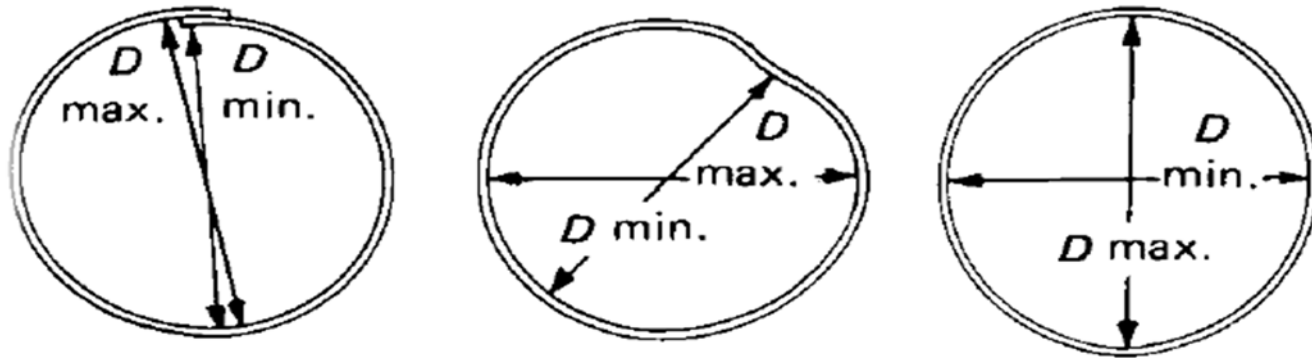
According to **UG-32**

$$\text{Knuckle Radius} = I.D * 0.17$$

$$\text{Crown Radius} = I.D * 0.9$$

2-1(c) Heads/Shell Forming Inspection UG-80(a)(2)

(Design : Internal Pressure)



Heads

- The difference in diameters shall not exceed 1%. (Ovality)

Shell

- The difference in diameters shall not exceed 1%. (Ovality)
- Permissible difference in inside diameters given above may be increased by 2% of the inside diameter of the opening. (Ovality)

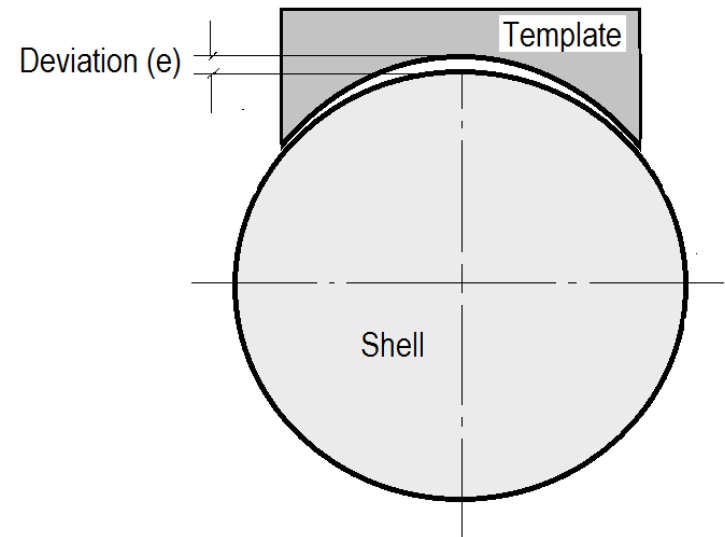
Formula: $[(\text{Maximum I.D} - \text{Minimum I.D}) / \text{Nominal I.D}] \times 100\% \leq 1\%$

2-1(d) Heads/Shell Forming Inspection UG-80(b)(2)

(Design : External Pressure)

□ Shell

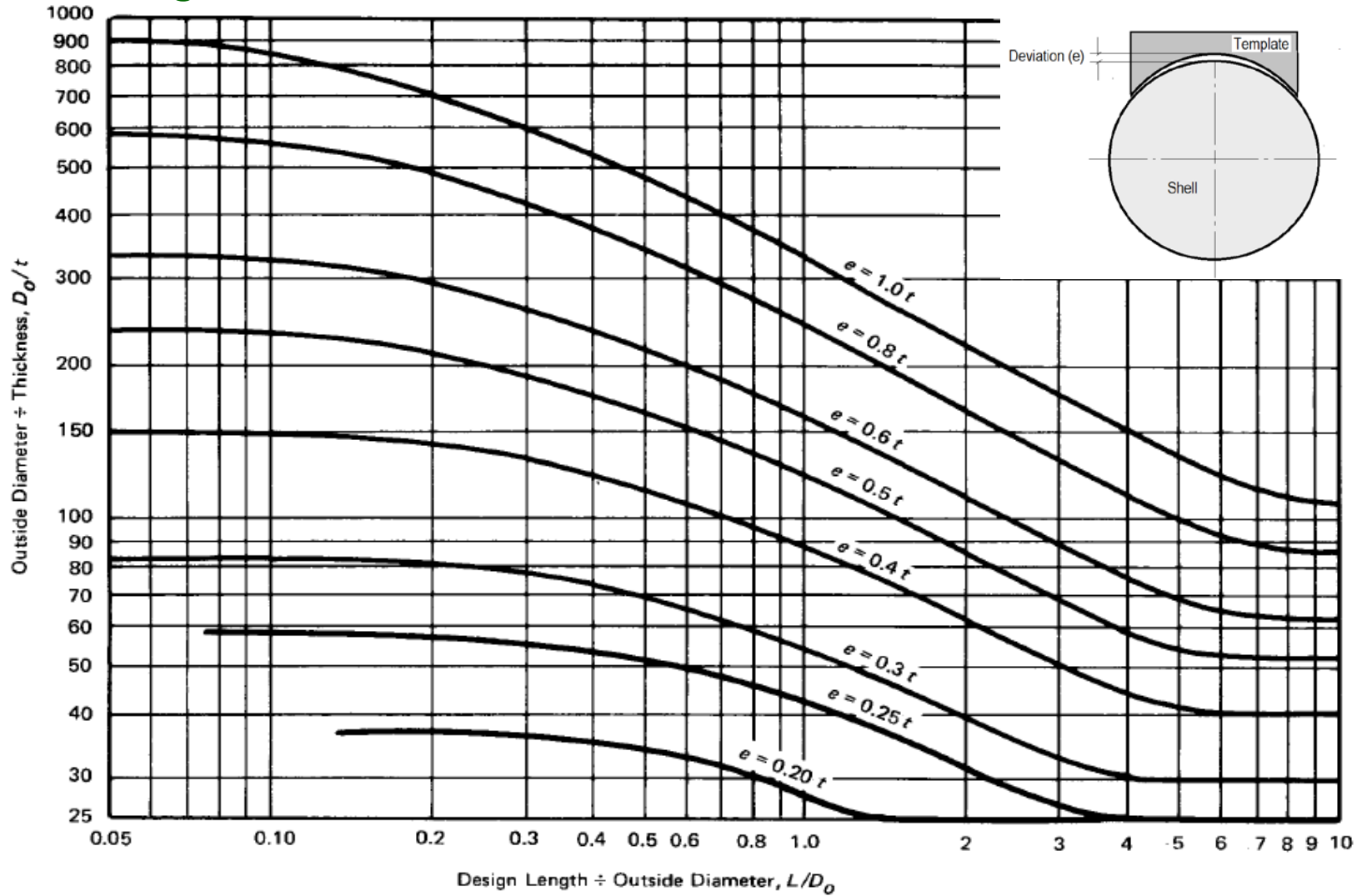
- Must meet requirements for Internal Pressure UG-80(a)(2).
- Must meet requirements in Figure UG-80.1.
- Measurement shall be made from a segmental circular template from the out side of shell.



INSPECTION REQUIREMENTS



Figure UG-80.1

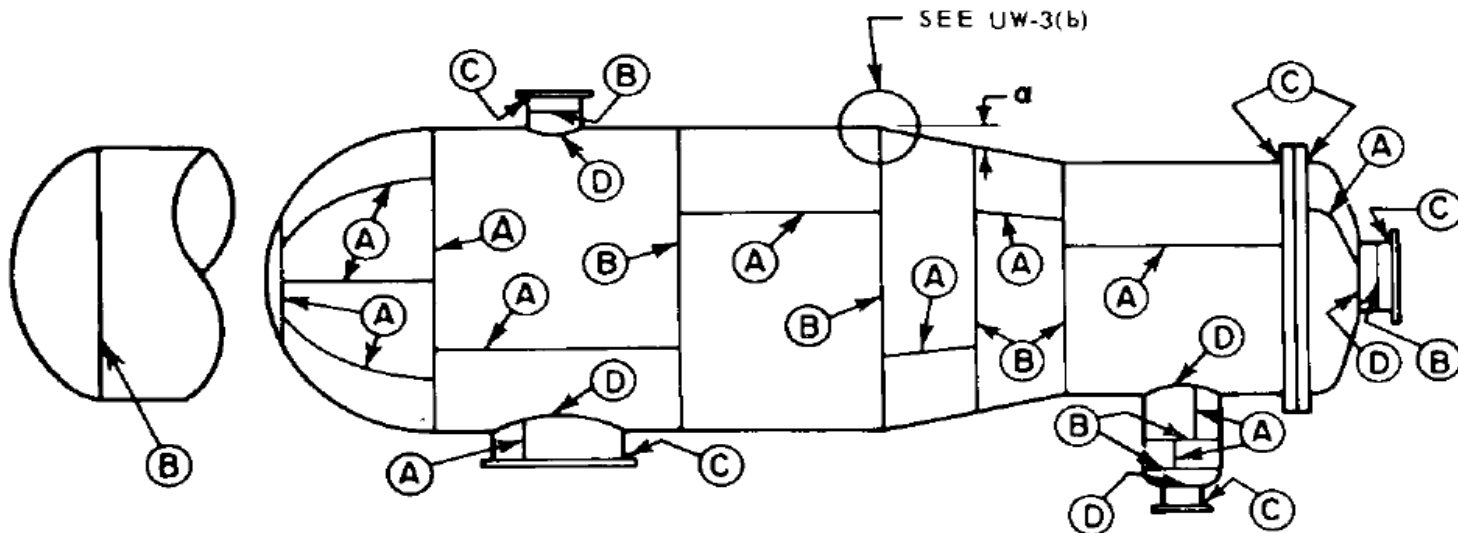


INSPECTION REQUIREMENTS



2-2(a) Alignment Requirement UW-33(a)

❑ Welded joint category **UW-3**.



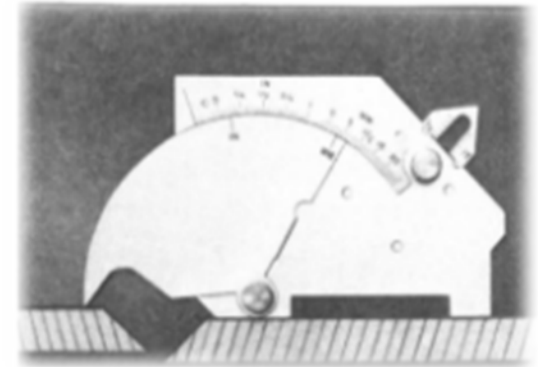
❑ UW-3 (b): Circumferential welded joints are butt joints if the angle(α) is equal to or less than 30 deg. (Otherwise will be a corner joint)

(Continued)

2-2(a) Alignment Requirement UW-33(a)

- Alignment of sections at edges to be butt welded shall be such that the maximum offset is not greater than as defined in UW-33

Section Thickness, mm	Joint Categories	
	A	B, C, & D
Up to 13, Incl.	$\frac{1}{4}t$	$\frac{1}{4}t$
Over 13 to 19, Incl.	3 mm	$\frac{1}{4}t$
Over 19 to 38, Incl.	3 mm	5 mm
Over 38 to 51, Incl.	3 mm	$\frac{1}{8}t$
Over 51	Lesser of $\frac{1}{16}t$ or 10 mm	Lesser of $\frac{1}{8}t$ or 19 mm

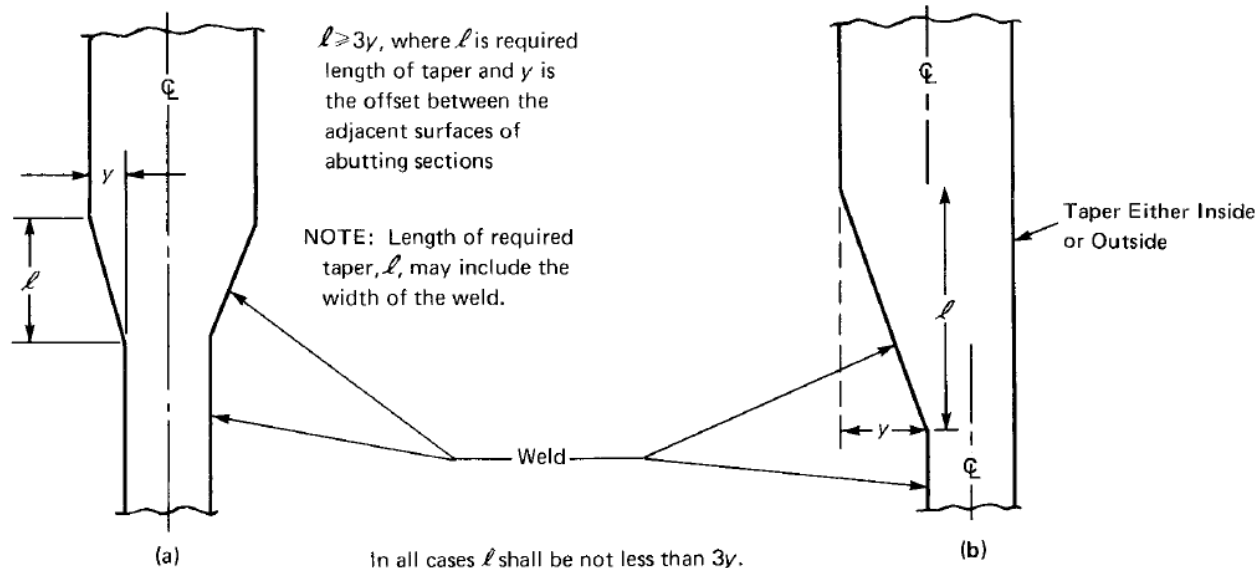


- The section thickness t is the nominal thickness of the thinner section at the joint.

2-2(b) Taper Transition UW-9(c), UW-33(b)

- ❑ When differ in thickness by more than one-fourth of the thickness ($t/4$) of the thinner section, or by more than $1/8$ in. (3 mm), whichever is less.
- ❑ Taper may be machined or welded.
- ❑ Weld metal build up shall be subject to the requirements of UW-42.

FIG. UW-9 BUTT WELDING OF PLATES OF UNEQUAL THICKNESS



INSPECTION REQUIREMENTS



2-3(a) Nozzles, Manholes and other attachments **UG-82 / UG-92**

- ❑ All attachments must be fit with the vessel outside or inside curvatures.
- ❑ Pressure parts, such as saddle type nozzles, manhole rings, and reinforcement around openings, extend over pressure retaining welds, such welds shall be ground flush for the portion of the weld to be covered.

UG-82(a) E.g. Nozzle Reinforcement Pad attachment.

- ❑ Non pressure parts, such as lugs, brackets, and support legs and saddles, extend over pressure retaining welds, such welds shall be ground

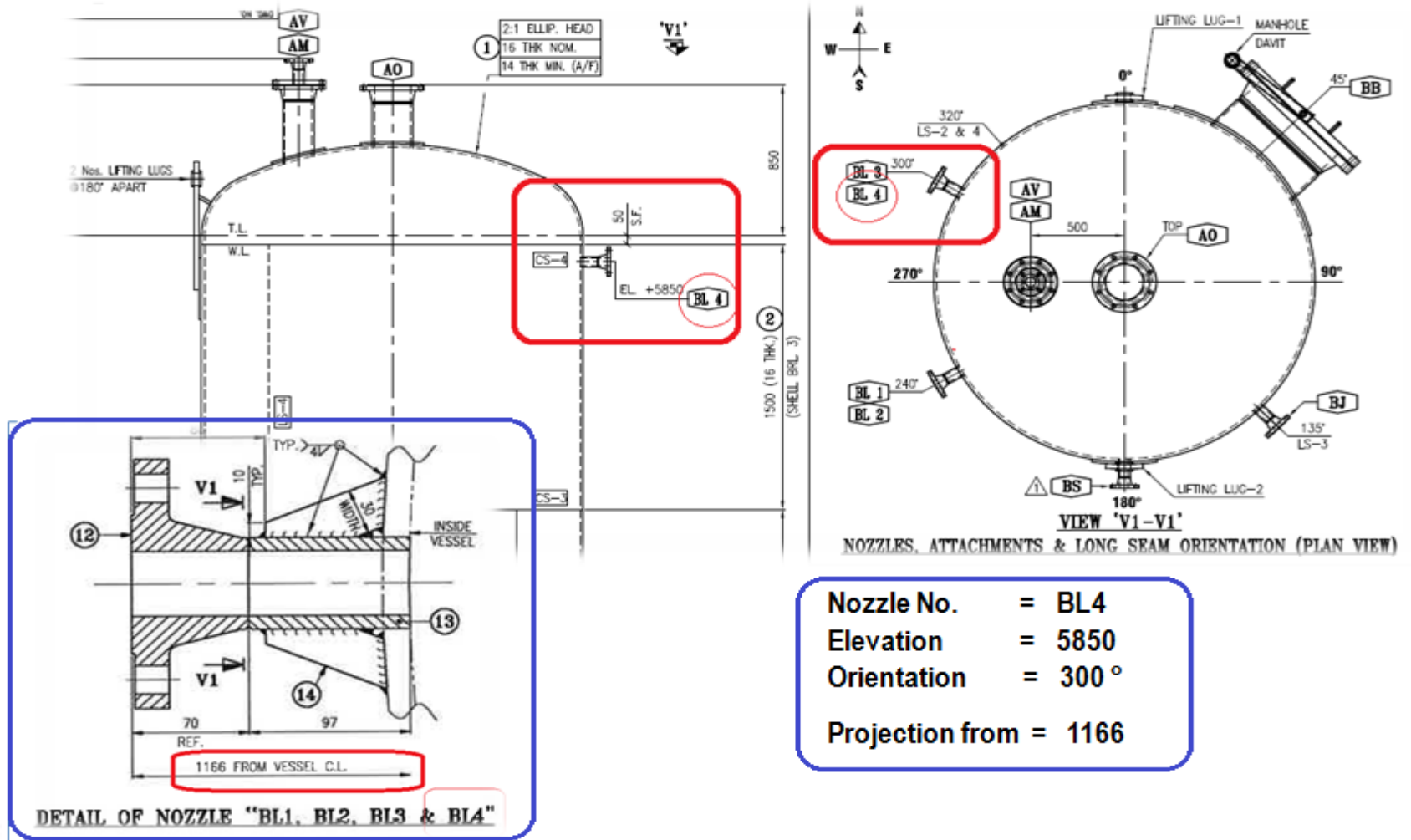
Typical Joint Connection	Applicable Figures in Division 1
Butt weld, plates of unequal thickness	UW-9, UW-13.1, ULW-17.1
Butt weld, weld necks to materials of unequal thickness	UW-13.4, ULW-17.1
Head to shell	UW-13.1, ULW-17.2, ULW-17.3
Nozzle or other appurtenance abutting a shell or head	UW-13.2, UW-13.3, UW-13.5, UW-16.1, UW-16.2, UHT-18.1, UHT-18.2, ULW-17.3, ULW-18.1
Stay bolts to shell or flange	UW-19.1
Tube to tubesheet	UW-20, ULW-17.3
Small fittings and couplings to shell or head	UW-16.1, UW-16.2

flush as described above, or such parts shall be notched or coped to clear those welds. **UG-82(b)** E.g. Insulation Ring

INSPECTION REQUIREMENTS



2-3(b) Nozzle and Manhole inspection Technique



(Continued)

INSPECTION REQUIREMENTS



2-3(b) Nozzle and Manhole inspection Technique



3- WELDING

- No welding of any kind be done when the temperature of the base metal is lower than -20°C . (UW-30)
- At temperatures between 0°C and -20°C , the surface of all areas within 75 mm of Welding shall be heated up to 15°C . (UW-30)
- Cleaning of the surface to be weld shall be as per UW-32(a)
- Surface shall be clean and free of scale, rust, oil, grease, slag, detrimental oxides, and other deleterious foreign material. UW-32(a)
- Welding Process shall be used as acceptable in UW-27.
- No welding to be done until the qualification are in place. (UW-26)
- GTAW-SMAW-SAW –FCAW-SMAW are most common. (UW-27)
- WPS/WQT shall qualification shall be as per UW-28 (WPS) & UW-29 (WQT) with provisions of ASME IX.

3-1(a) Welding Requirements (Safety First)

3-1(a-1) Before Welding

- Review of weld book.
(WPS, PQR, Weld Map/Matrix, WQT)
- Consumables and MTRs.
- Welding process and ancillaries (cable, Regulator, Oven, e.t.c).
- Tack welding material.

3-1(a-2) During Welding

- Pre-heat values (Heating method, location and control method)
- In-process distortion control (Sequence or balanced welding)
- Consumable control (Specification, size, condition, and any special treatments)
- Welding Procedure requirements.
- Arc Strikes

INSPECTION REQUIREMENTS

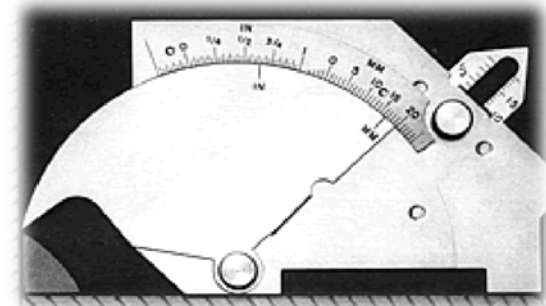


3-1(a-3) After Welding

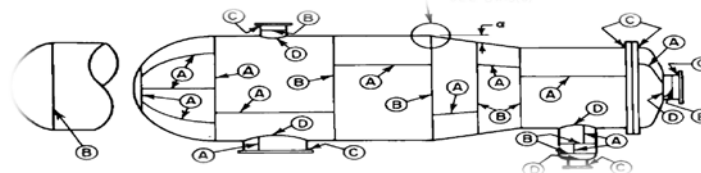
❑ Carry out visual inspection of the welded joint **UG-97**. (Profile, Defect e.t.c)

❑ Longitudinal and circumferential Butt Joints,

These joints shall also be checked for weld reinforcement height as per **UW-35**.



Material Nominal Thickness, mm	Maximum Reinforcement, mm.	
	Category B & C Butt Welds	Other Welds
Less than 2.4	2.4	0.8
2.4 to 4.8, incl.	3.2	1.6
Over 4.8 to 13, incl.	4.0	2.4
Over 13 to 25, incl.	4.8	2.4
Over 25 to 51, incl.	5	3.2
Over 51 to 76, incl.	6	4
Over 76 to 102, incl.	6	6
Over 102 to 127, incl.	6	6
Over 127	8	8



❑ Weld size (Leg length) of Nozzles and other parts shall be checked as per **UW-16**, Drawing or Specs.

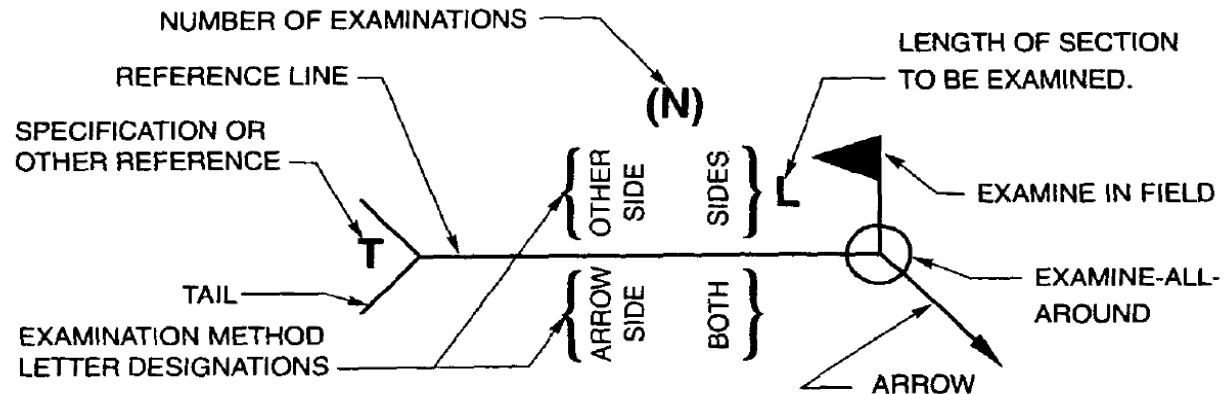
(Continued)

3-1(a-3) After Welding

- ❑ In case of any rejection during visual inspection repair or build up shall be made as per **UW-38** and **UW-42**.
- ❑ After the completion of welding it is important for welder or operator to punch his identification number, stamp or symbol at interval of 1m along the weld for traceability and to satisfy **UW-37** equipments.

(Punching Thickness limitation: 6mm for ferrous and 13mm for non ferrous)

Welding Symbols



Standard Location of Elements

INSPECTION REQUIREMENTS



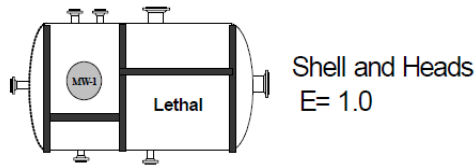
4- NDE (Non Destructive Examination) Part UW and ASME Sec. V

When required acceptance criteria:

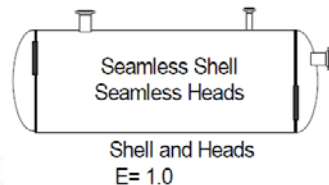
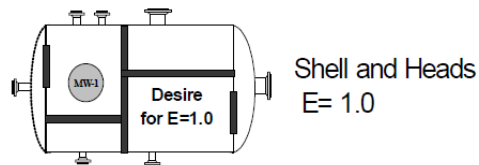
UW- 51 (Full RT) & **UW-52** (Spot RT) [**also see UW-14**]

RT Types

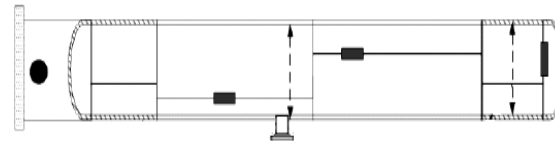
RT-1 (Full):



RT-2 :



RT-3 : (Spot)



RT-4 : (Spot)



5- PWHT (Post Weld Heat Treatment) UW-2, UW-40, UCS-56

- ❑ When required (as per UW-2, UW-40 and specs) PWHT must be performed according to UCS-56 and Table-UCS-56.
- ❑ Review PWHT specification for specified thickness and material and verify PWHT graph as per UCS-56(c)(2), UCS-56(d)(1), UCS-56(d)(2), UCS-56(d)(3), UCS-56(d)(5), UCS-56(d)(2) and Table no. UCS-56.
- ❑ Also follow WPS.

TABLE UCS-56
POSTWELD HEAT TREATMENT REQUIREMENTS FOR CARBON AND LOW ALLOY STEELS (CONT'D)

Material	Normal Holding Temperature, °F (°C), Minimum	Minimum Holding Time at Normal Temperature for Nominal Thickness [See UW-40(f)]		
		Up to 2 in. (50 mm)	Over 2 in. to 5 in. (50 mm to 125 mm)	Over 5 in. (125 mm)
P-Nos. 5A, 5B Gr. No. 1, and 5C Gr. No. 1	1,250 (675)	1 hr/in. (25 mm), 15 min minimum	1 hr/in. (25 mm)	5 hr plus 15 min for each additional inch (25 mm) over 5 in. (125 mm)

6- HYDRO TESTING (UG-99)

- Vessel shall be tested after completion of all fabrication and examinations. **UG-99 (a)(1), UG-99 (a)(2).**
- Cosmetic and Grinding on the base metal is allowed after this test. **UG-99 (a)(2).**
- Testing pressure : $1.3 \times (\text{MAWP}) \times (\text{Lowest Stress Ratio})$
UG-99 (a)(2)(b).
- The hydrostatic test pressure at the top of the vessel shall be the minimum of the test pressures.
- Any nonhazardous liquid at any temperature may be used for the hydrostatic test if below its boiling point. **UG-99(h)**
- Combustible liquids having a flash point less than 43°C, Such as petroleum distillates, may be used only for near atmospheric temperature tests. **UG-99(h)**

6- HYDRO TESTING (UG-99)

- Metal temperature during hydrostatic test. **UG-99(h)**
17°C minimum above the MDMT and 48°C maximum
- Liquid relief valve set to 1-1/3 times the test pressure is recommended for the pressure test system. **(Caution)**
- Vent shall be provided at the heights point to purge air. **UG-99(i)**
- The maximum allowable working pressure may be assumed to be the same as the design pressure when calculations are not made to determine the maximum allowable working pressure. **(Foot Note 34 of Ed.2013)**
- Pressure chambers of combination units that have been designed to operate independently shall be hydrostatically tested as separate vessels. **UG-99(e)(i)**
- Vessels may be tested after painting (Internal/External) except for those in lethal service, Other lines may be painted after leak test. **UG-99(k)**

6-1 PNEUMATIC TEST (UG-100)

This test may be used in lieu of hydro test. **UG-100(a)**

(1) That are so designed and/or supported that they cannot safely be filled with water. **UG-100(a)(1)**

(2) Not readily dried, that are to be used in services where traces of the testing liquid cannot be tolerated. **UG-100(a)(2)**

Testing pressure : $1.1 \times (\text{MAWP}) \times (\text{Lowest Stress Ratio})$ **UG-100 (b)**

Metal Temperature 17°C minimum above the MDMT . **UG-100 (c)**

The pressure in the vessel shall be gradually increased to not more than one-half of the test pressure. Thereafter, the test pressure shall be increased in steps of approximately one-tenth of the test pressure until the required test pressure has been reached. **UG-100 (d)**

6-2 CLOSE INSPECTION

❑ HYDRO TEST

Maintains this test pressure for 10 minutes before inspection. Then, if test is above maximum allowable working pressure (MAWP), reduces to MAWP while making a full thorough inspection for leaks.

❑ PNEUMATIC TEST

Reduces the pressure to the maximum operating pressure before proceeding with the inspection; holds the pressure for a sufficient period of time to permit inspection of the system.

6-3 TEST GAGES (UG-102)

- An indicating gage shall be connected directly to the vessel at top of the vessel. **UG-102 (a)**
- Range shall be less than 1-1/2 nor more than 4 times that pressure. **UG-102 (b)**
- Degree of accuracy in digital gage is more than dial gage. **UG-102 (b)**
- All gages shall be calibrated against a standard deadweight tester or a calibrated master gage. **UG-102 (b)**
- Gages shall be recalibrated at any time that there is reason to believe that they are in error. (Practice: 6 months) **UG-102 (c)**

INSPECTION REQUIREMENTS

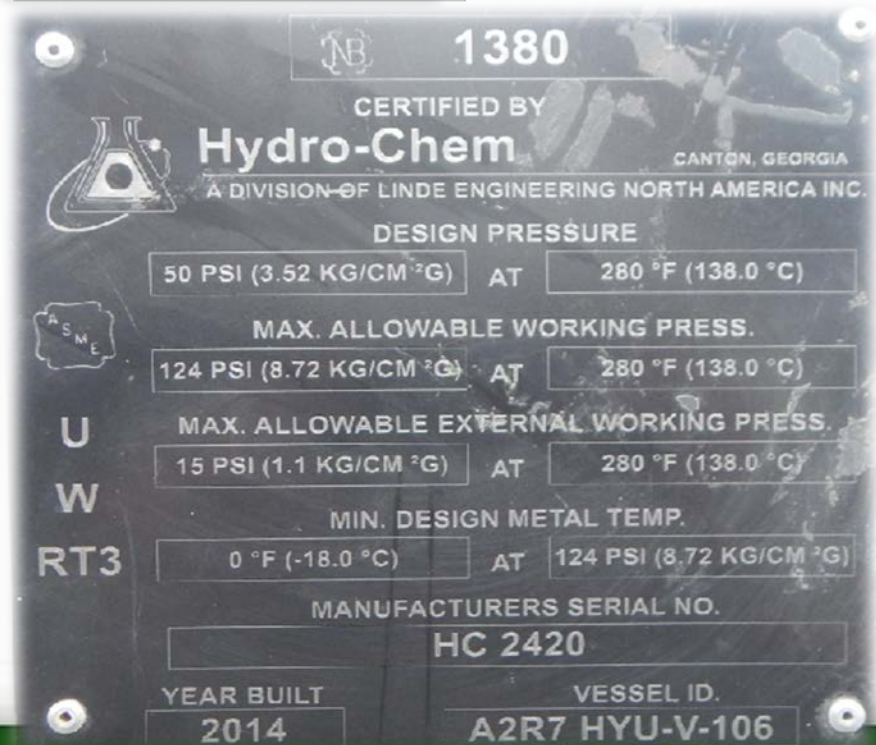
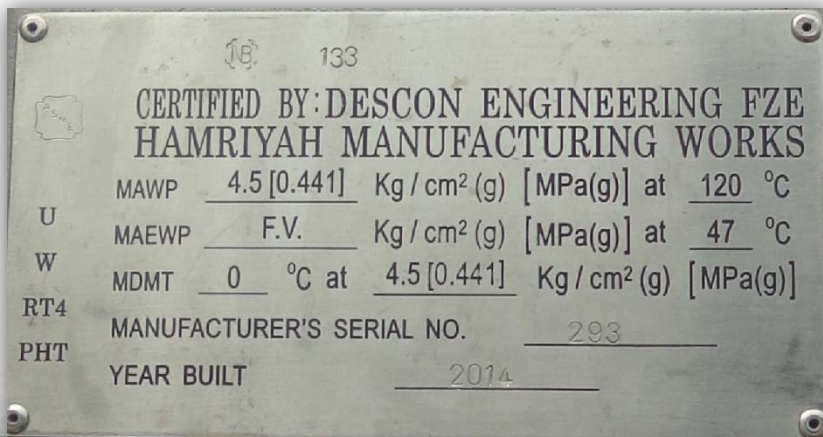


7- NAME PLATE

- Vessel Marking. **UG-116**
- Certification and Authorized inspection mark. **UG-117**
- Marking Method. **UG-118**

Lethal Service	L
Unfired Steam Boiler	UB
Direct Firing	DF

Type of Construction	Letter(s)
Arc or gas welded	W
Pressure welded (except resistance)	P
Brazed	B
Resistance welded	RES



8- DATA REPORT (MDR/PDR)

UG-120, Non Mandatory Appendix W

- Form U 1 (Exchangers)
- Form U1-A (Pressure vessel, Single Chamber)
- Form U1-B (Graphite Pressure Vessel)
- Form U1-P (Plate Type Heat Exchanger)
- Form U2 (Pressure Vessel Part Fabricated by Another Manufacturer)
- Form U-2A (Pressure Vessel Part Fabricated by Another Manufacturer)
- Form U 3
- Form U-3A
- Form U4 (Supplementary Sheet for Vessels)
- Form U5 (Supplementary Sheet for Tube and Shell Type Exchangers)

INSPECTION REQUIREMENTS



9- TOLERANCE SHEET

Attachment 2

0-202 *1/24/10*

Appendix 4 - 1/2
(unit : mm)

APPENDIX 4 TOLERANCES FOR PRESSURE VESSELS

(SHELLS AND HEADS)

Tolerances for shape of formed heads and non-circularity of shells shall be as specified in the applicable codes.

1. Overall length between T.L.:

± 1.5 or ± 1.5 per 1000, whichever is greater, but not exceed the following values

Length (L)	Tolerance
$L \leq 30000$	± 25
$L > 30000$	± 40

2a. Inside diameter as determined by circumferential measurements:

Nominal I.D. (D)	Tolerance
$D \leq 1200$	± 3
$1200 < D \leq 2100$	± 5
$2100 < D \leq 4000$	± 8
$4000 < D \leq 6000$	± 7
$6000 < D \leq 8000$	± 8
$8000 < D \leq 10000$	± 10
$10000 < D$	± 16

2b. Outside diameter of vessels with internal trays (by direct measurement):

$\pm 0.5\% \times$ Nominal I.D.

3. Straightness (deviation of shell external surface from a straight line)

(1) Max. ϕ in any 8000 length

(2) As measured in the total length (refer bottom to top T.L.):

Length (L)	Tolerance
$L \leq 20000$	Max. 19
$L > 20000$	Max. 22

(NOZZLES, MANHOLES AND OTHER ATTACHMENTS)

4a. Location of nozzle from T.L. : ± 6

4b. Orientation of nozzle from reference centerline : ± 6

4c. Nozzle flange face from shell external surface : ± 6

4d. Alignment of nozzle flange face : $\pm 10^\circ$

4e. Rotational orientation of bolt hole at bolt circle : Max. 2.5

4f. Top (or bottom) flange face from adjacent T.L. : ± 10

4g. Location of nozzle on top head from center of head : ± 6

4h. Flange face of bottom draw-off nozzle from reference centerline : ± 10

5a. Location of manhole from T.L. : ± 10

5b. Orientation of manhole from reference centerline : ± 10

5c. Manhole flange face from shell external surface : ± 10

5d. Alignment of manhole flange face : $\pm 1^\circ$

6. Location of nozzle and manhole (related to trays) from tray support ring on shell as Vessel Drawing : ± 3

1. Any pair of nozzles (i.e. nozzles for liquid level gauge and connected to reboiler)

7a. Difference in nozzle length : Max. 1

7b. Distance between nozzles : ± 2

7c. Difference in orientation : Max. 2

7d. Alignment of flange face : $\pm 1/4^\circ$

2. Clips or other similar structural attachments for platform, ladder or pipe support

2a. Location from T.L. : ± 10

2b. Orientation from reference centerline : ± 10

2c. Distance between any pair of clips : ± 3

(SUPPORTS (SKIRT, LUGS, LEGS AND SADDLES))

3a. Distance from T.L. to bottom of baseplate (height of skirt or leg)

Nominal I.D. (D)	Tolerance
$D \leq 2100$	± 6
$D > 2100$	± 9

3b. Distance from T.L. to bottom of baseplate (height of skirt or leg)

Nominal I.D. (D)	Tolerance
$D \leq 2100$	Max. 3
$2100 < D \leq 4000$	Max. 6
$4000 < D \leq 6000$	Max. 7
$6000 < D \leq 8000$	Max. 8
$8000 < D \leq 10000$	Max. 10
$10000 < D$	Max. 15

3c. Distance from T.L. to support lug : ± 6

11. Bolt circle diameter and pitch between bolt holes:

Nominal I.D. (D)	Tolerance
$D \leq 2100$	± 3
$D > 2100$	± 6

12. Horizontal vessels

12a. Distance from reference centerline to bottom of support saddle : ± 6

12b. Distance from T.L. to bolt hole center of support saddle : ± 6

12c. Distance between bolt holes of support saddle:

Nominal I.D. (D)	Tolerance
$D \leq 2100$	± 3
$D > 2100$	± 6

13a. Location of tray support ring from bottom T.L. : ± 10

13b. Tray support ring out-of-level (difference between max. and min. distances from T.L. to tray support ring):

Nominal I.D. (D)	Tolerance
$D \leq 1500$	Max. 2
$1500 < D \leq 2500$	Max. 3
$2500 < D \leq 4000$	Max. 4
$4000 < D \leq 6000$	Max. 6
$6000 < D \leq 8000$	Max. 8
$8000 < D \leq 10000$	Max. 10
$10000 < D$	Max. 12

14. Distance between adjacent tray support rings:

Distance (S)	Tolerance
$S \leq 300$	± 3
$S > 300$	± 4

15. Height of downcomer support bar above tray support ring : ± 1.5

16. Bottom of downcomer support bar above tray support ring : ± 3

17. Distance between bolt holes of downcomer support bar : ± 7

18. Distance from reference centerline to downcomer support bar : ± 3

19. Out-of-level of baseplate (difference between max. and min. distances from T.L. to baseplate):

Nominal I.D. (D)	Tolerance
$D \leq 2100$	Max. 3
$2100 < D \leq 4000$	Max. 6
$4000 < D \leq 6000$	Max. 7
$6000 < D \leq 8000$	Max. 8
$8000 < D \leq 10000$	Max. 10
$10000 < D$	Max. 15

20. Distance between adjacent tray support rings:

Distance (S)	Tolerance
$S \leq 300$	± 3
$S > 300$	± 4

21. Height of downcomer support bar above tray support ring : ± 1.5

22. Bottom of downcomer support bar above tray support ring : ± 3

23. Distance between bolt holes of downcomer support bar : ± 7

24. Distance from reference centerline to downcomer support bar : ± 3

REMARKS:

- Unless otherwise stated, all dimensions and tolerances are given in (mm).
- T.L. : Tangent Line
- Tolerances are not cumulative.
- Tolerances indicated on Vessel Drawing shall govern.
- Tolerances shown herein are intended to apply to both vertical and horizontal vessels.
- For vessels fabricated from pipes, diameter tolerances shall be in accordance with the relevant standards.
- Tolerances as shown in 2a, 2b and 3 are not applied to distortion caused by welding for attaching parts, such as nozzles, support rings, legs and other fittings to shells and heads. Measurements shall be made to the surface of the parent plate and not to a weld, fitting or other raised parts.
- Even if the distance to flange face of nozzle (or manhole) from centerline of vessel is specified on Vessel Drawing, measurements shall be made as shown in 4c (or 5c).

SUMMARY

SUMMARY



- ❑ Verifying that the Manufacturer has a valid Certificate of Authorization UG-117(a) and is working to a Quality Control System UG-117(e).
- ❑ Verifying that the applicable design calculations are available [U-2(b), U-2(c), mandatory Appendix 10-5, and 10-15(d)].
- ❑ Verifying that materials used in the construction of the vessel comply with the requirements of UG-4 through UG-14 and UG-76, UG-77, UG-78 and UG-93.
- ❑ Verifying that all welding procedures have been qualified with the requirements of UW-27, UW-28, UW-47 and ASME Section IX.
- ❑ Verifying that all welders, welding operators, have been qualified with the requirements of UW-29, UW-48 and ASME Section IX.
- ❑ Verifying that the heat treatments, including PWHT, have been performed according to UG-85, UW-10, UW-40, UW-49, and UF-52.

(Continued)

SUMMARY



- ❑ Verifying that material imperfections repaired by welding were acceptably repaired by meeting the requirements of UG-78, UW52(d)(2)(c), UF-37, and UF-47(c).
- ❑ Verifying that weld defects were acceptably repaired and acceptable in UW-51(c) and UW-52(c).
- ❑ Verifying that required nondestructive examinations have been performed and that the results are acceptable to UW-50, UW-51, UW-52
- ❑ Verifying that required impact test and Lateral Expansion have been performed and that the results are acceptable UG-84, UG-93 and UHA-51.
- ❑ Making a visual inspection of vessel to confirm that the material identification numbers have been properly transferred as required in UG-77 and UG-94.

(Continued)

SUMMARY



- ❑ Making a visual inspection of the vessel to confirm that there are no material or dimensional defects as defined UG-95, UG-96, and UG-97.
- ❑ Performing internal and external inspections and witnessing the hydrostatic or pneumatic tests (UG-80, UG-96, UG-97)
- ❑ Verifying that required PWHT has been performed and that the graph is acceptable to the requirements of UCS-56.
- ❑ Hydro or Pneumatic test performed as per UG-99, UG-100 and UG-102.
- ❑ Verifying that the required marking is provided (UG-115) and that any nameplate has been attached to the proper vessel.
- ❑ Signing the Certificate of Inspection on the Manufacturer's Data Report when the vessel, to the best of his knowledge and belief, is in compliance with all the provisions of this Division.

QUESTIONS

THANK YOU !