Delayed Coker Specification

Thomas E. Wolf

COKE DRUM SPECIFICATION

Contents

1. GENERAL

1.1. **Revision Number:** _____ **Revision Date:** _____

1.2. **By:** _____ **Checked:** _____ **Approved:** _____

1.3. **Client:** _____

1.4. **Project Name:** _____

1.5. **Project Location:** _____

1.6. **Project Number:** _____

1.7. **Item Numbers:** _____

1.8. **Name:** _____

1.9. **Service:** _____

1.10. **Request For Quotation Number:** _____

1.11. **Purchase Order Number:** _____

1.12. **Owner/Engineer Contact:** _____

1.13. **Owner/Engineer Contact Information:**

- _____
- _____
- _____

1.14. **Supplier/Fabricator:** _____

1.15. **Supplier/Fabricator Contact:** _____

1.16. **Supplier/Fabricator Contact Information:**

- _____
- _____
- _____

1.17. **Shop Location:** _____

1.18. **Shop Order Number:** _____

1.19. _____

1.20. _____

2. CODES AND STANDARDS

2.1. **Design Code**

2.1.1. These vessels to be designed and fabricated in accordance with ASME Code Section VIII Division 1, Section II, Section V, and Section IX and latest Addendums.

2.1.2. Vessels to be code stamped: **YES**

2.1.3. Vessels require National Board Registration: **YES** ____**NO** ____

2.2. **Wind Design**

_____

2.3. **Seismic Design**

_____

2.4. _____

2.5. **Additional Specifications and Standards**

2.5.1._____

2.5.2._____

2.5.3._____

3. DIMENSIONS AND QUANTITIES

3.1. **Dimensions List/No Duplication** - All dimensions and quantities are to be listed in this section below and not to be duplicated elsewhere within this document. All revisions to dimensions and quantities are to be listed in this section below and not to be duplicated elsewhere within this document. Only dimensions and quantities are to be included in this section; that is, all notes, clarifications, requirements, etc. are to be included in subsequent sections.

3.2. **Reference Dimensions and Quantities –** All referenced dimensions, lengths, diameters, radii, angles, quantities, etc. required are in accordance with the attached sketches, see paragraphs 3.6 through 3.13, below.

3.3. **Origination and Verification –** The Owner/Engineer specifies certain dimensions and quantities and the Supplier/Fabricator verifies the dimensions and quantities are per Code and specification. The Supplier/Fabricator specifies certain other dimensions and quantities and the Owner/Engineer verifies the dimensions and quantities are acceptable and per requirements.

3.4. **Dimensional System –**

- Customary Units, English (feet, inches, etc.) or
- SI Units, Metric (meters, millimeters, etc.)

3.5. **Input – Quantities and Dimensional Data** (for multiple drums, Quantities and Dimensional Data may vary).

3.5.1. **Quantities**

X1 - _____ Number of Drums

X2 – __below___ Duration of coking cycle (see P-T Diagram, Para 4.4)

X3 - _____ Number of years expected before first shutdown due to major repairs

X4 - _____ Number of anchor bolts

X5 - _____ Number of skirt slots

X6 - _____ _____ **X7 -** _____ _____

3.5.2. **Diameters**

D1 - _____ Drum inside diameter

D2 - _____ Inside base plate diameter

D3 - _____ Inside skirt diameter

D4 - _____ Outside skirt diameter

D5 - _____ Anchor bolt circle diameter

D6 - _____ Outside base plate diameter

D7 - _____ Skirt slot hole diameter, top and bottom of slot

D8 - _____ Anchor bolt diameter

D9 - _____ Top anchor bolt chair plate hole diameter

D10 - _____ _____

D11 - _____ _____

3.5.3. **Lengths**

L1 - _____ Overall Length

L2 - _____ Tangent to Tangent Length

L3 - _____ Top tangent line to top nozzles flange face length

L4 - _____ Bottom tangent line to bottom nozzle flange face, M1

L5 - _____ Bottom tangent line to bottom of base plate length

L6 - _____ Bottom tangent line to centerline of feed nozzle, N1

L7 - _____ Btm tangent line to centerline of level instrument LV1

L8 - _____ Btm tangent line to centerline of level instrument LV2

L9 - _____ Btm tangent line to centerline of level instruments LV3 and LV4

L10 – _____ Btm tangent line to nominal top of coke during coking cycle

L11 - _____ Anchor bolt length above top of concrete

L12 - _____ Baseplate anchor bolt slotted hole length

L13 - _____ Baseplate anchor bolt slotted hole width

L14 - _____ Height of anchor bolt chair plate

L15 - _____ Top of Skirt to btm tangent line (for overlapping skirt)

L16 - _____ Skirt slot distance to bottom tangent line

L17 - _____ Skirt slot length

L18 - _____ Skirt slot width

L19 - _____ Hot box distance to bottom tangent line

L20 - _____ Nozzle M1 face of flange to weld bevel length

L21 - _____ Cone, lower straight flange length

L22 - _____ Cone, upper straight flange length

L23 - _____ _____

L24 - _____ _____

3.5.4. **Radii**

R1 - _____ N1 nozzle flange face to centerline of drum radius

R2 - _____ N2 nozzle centerline to centerline of drum radius

R3 - _____ N3 nozzle centerline to centerline of drum radius

R4 - _____ N4 nozzle centerline to centerline of drum radius

R5 - _____ N5 nozzle centerline to centerline of drum radius

R6 - _____ N6 nozzle centerline to centerline of drum radius

R7 - _____ Cone, inside top knuckle radius, IKR_T

R8 - _____ Cone, outside bottom knuckle radius, OKR_B

R9 - _____ Inside (weld) junction radius, see Para. 3.9

R10 - _____ _____

R11 - _____ _____

3.5.5. **Angles**

Θ - _____ Cone angle

Θ1 - _____ N1 nozzle orientation

Θ2 - _____ N2 nozzle orientation

Θ3 - _____ N3 nozzle orientation

Θ4 - _____ N4 nozzle orientation

Θ5 - _____ _____

Θ6 - _____ _____

Θ7 - _____ LV1 level detector orientation

Θ8 - _____ LV2 level detector orientation

Θ9 - _____ LV3 level detector orientation

Θ10 - _____ LV4 level detector orientation

Θ11 - _____ _____

Θ12 - _____ _____

3.5.6. **Thicknesses** (including Corrosion Allowance, see Para. 5.3 and 9.4, as applicable)

T1 - _____ Head

If uniform shell:

T2 - _____ Shell

If stepped shell:

$T2_1$ - _____ Shell course from Btm tan line to _____

$T2_2$ - _____ Shell course from _____ to _____

$T2_3$ - _____ Shell course from _____ to _____

$T2_4$ - _____ Shell course from _____ to _____

$T2_5$ - _____ Shell course from _____ to _____

$T3_1$ - _____ Cone

$T3_2$ - _____ Cone, upper straight flange

$T3_3$ - _____ Cone, lower straight flange

T4 - _____ Baseplate

T5 - _____ Skirt

T6 - _____ Anchor Bolt Chair Top Plate

T7 - _____ Anchor Bolt Chair Support Plates

T8 - _____ Hot Box Ring

T9 - _____ Insulation Support Rings

T10 - _____ Insulation thickness

T11 - _____ _____

T12 - _____ _____

3.5.7.**Nozzle Schedule**

Mark	**Qty**	**Size**	**Rating**	**Service**
M1	1	72″ I.D.	Special	Bottom Outlet/Manway
M2	1		Special	Top Access/Manway
N1				Feed Inlet (specify number of inlet nozzles)
N2	1			Vapor Outlet
N3	1			Anti-Foam
N4	1			Relief Valve
LV1	1		N/A	Level Detector
LV2	1		N/A	Level Detector
LV3	1		N/A	Level Detector
LV4	1		N/A	Level Detector

3.5.8. **Top Head** (specify type)

_____ 2:1 Elliptical

_____ Hemispherical

3.5.9. **Deheading Devices** (specify)

- **Bottom**
  - Included (yes/no) _____
  - Manufacturer _____
  - Vessel flange provided by _____ and installed by vessel Supplier/Fabricator.
- **Top**
  - Included (yes/no) _____
  - Manufacturer _____
  - Vessel flange provided by _____ and installed by vessel Supplier/Fabricator.

3.5.10. **Cone/Shell/Skirt Junction** (specify type)

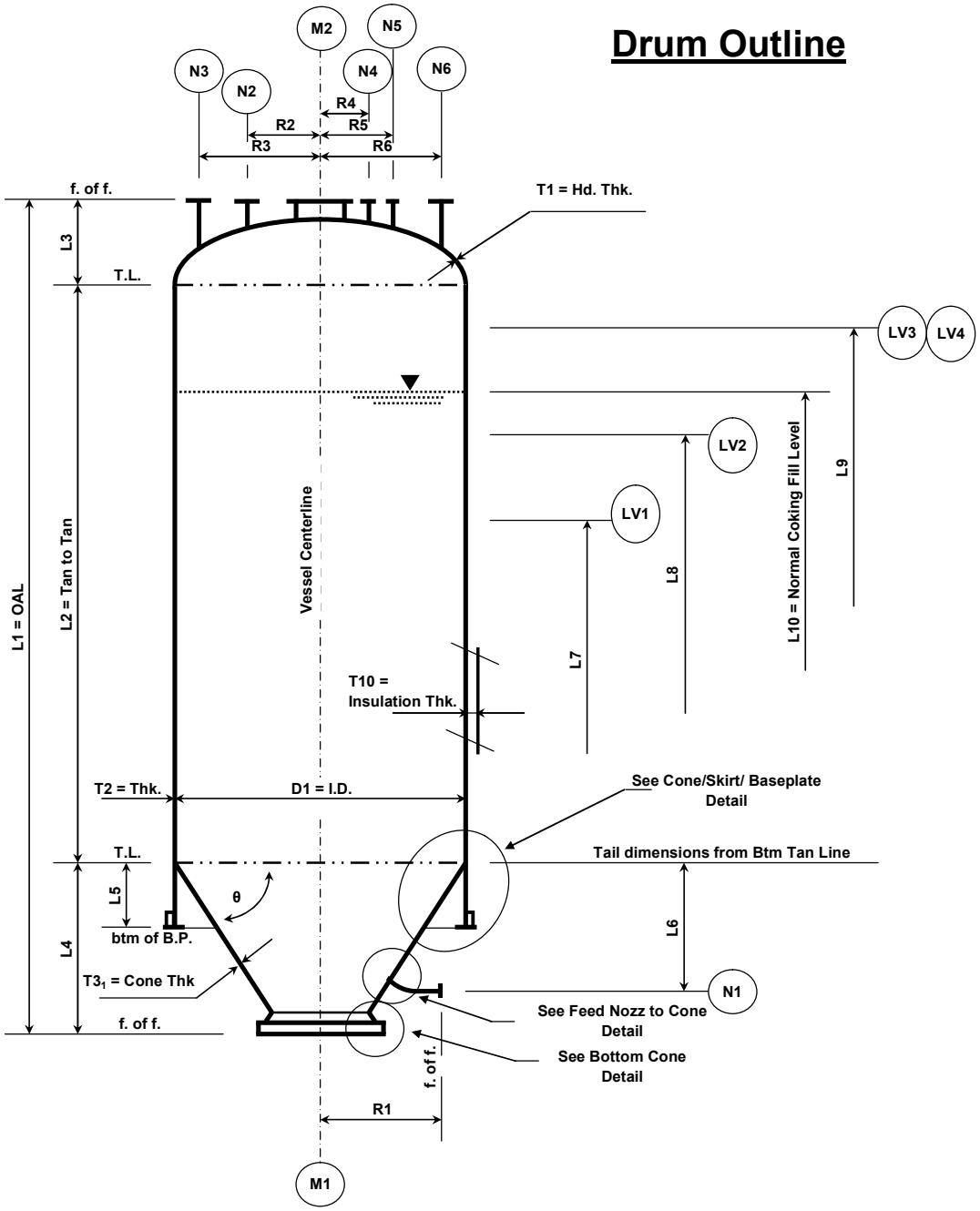
_____ In-line

_____ Overlapping

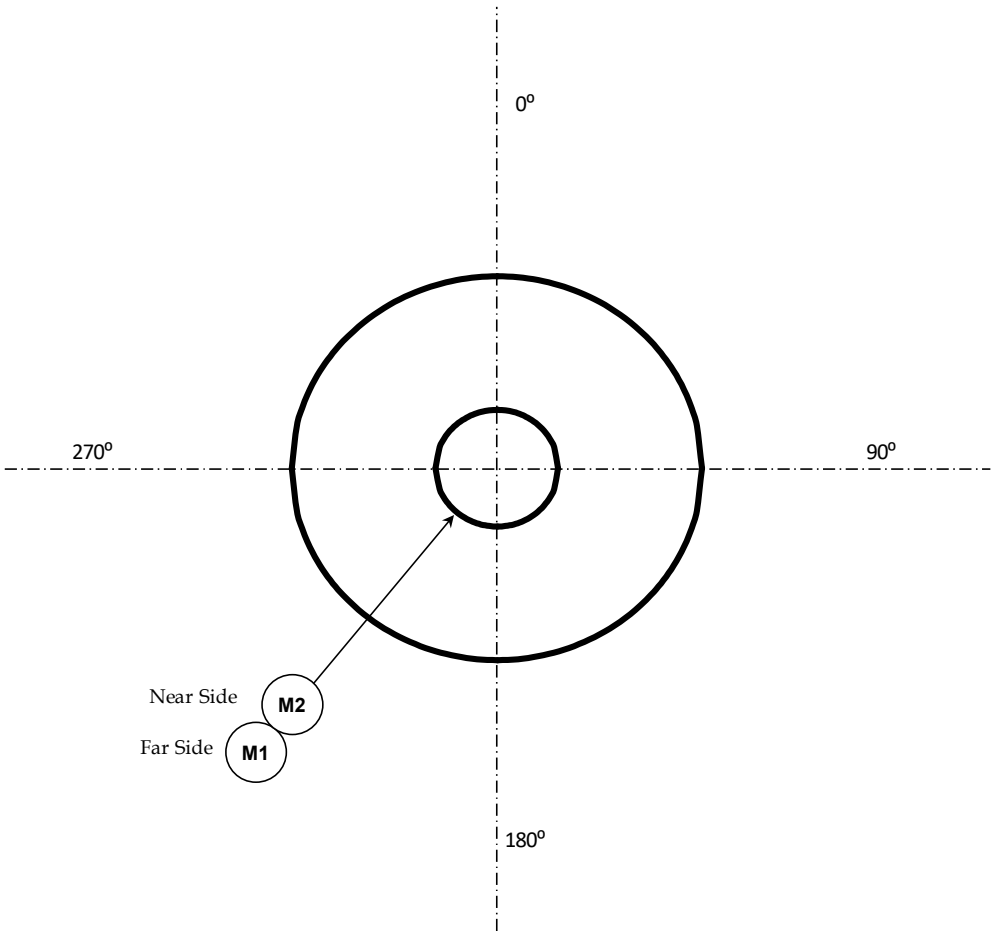
_____ Proprietary

_____ _____

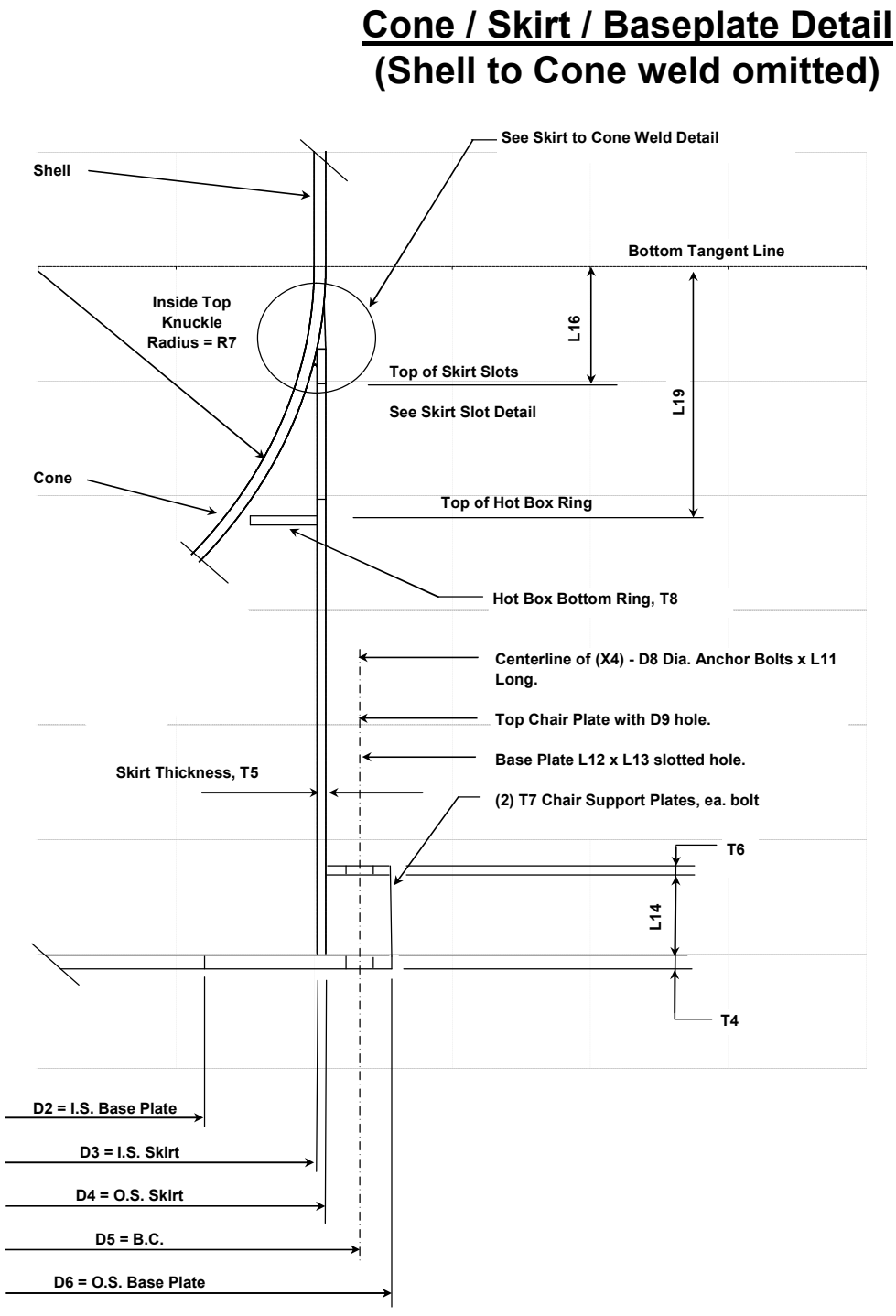
3.6. **Drum Outline**



3.7. **Drum Orientation**

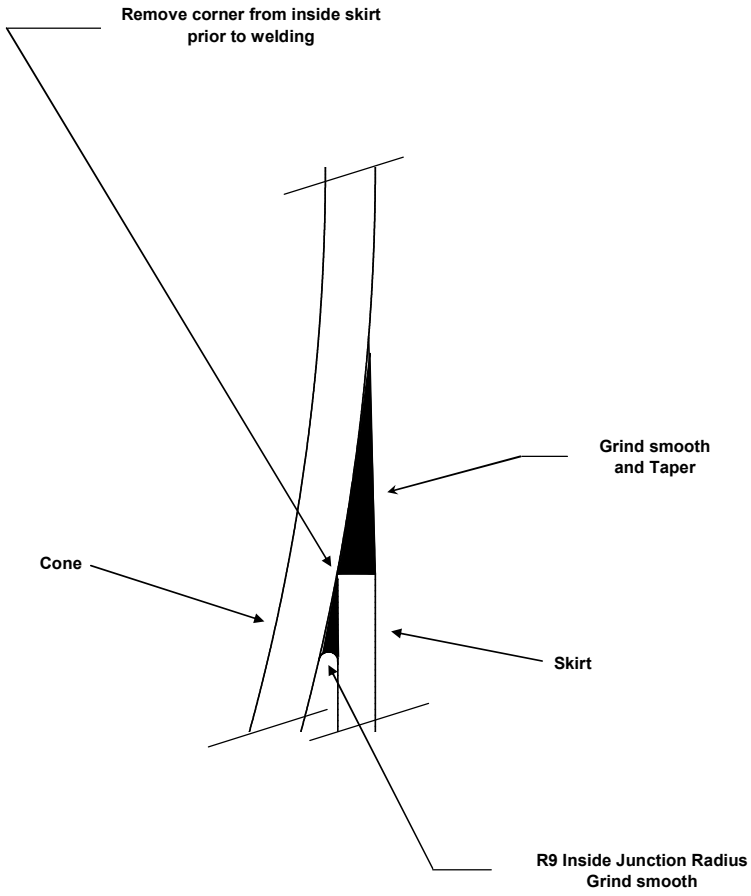


3.8. **Cone/Shell/Skirt/Baseplate Detail – shown with In Line Skirt**



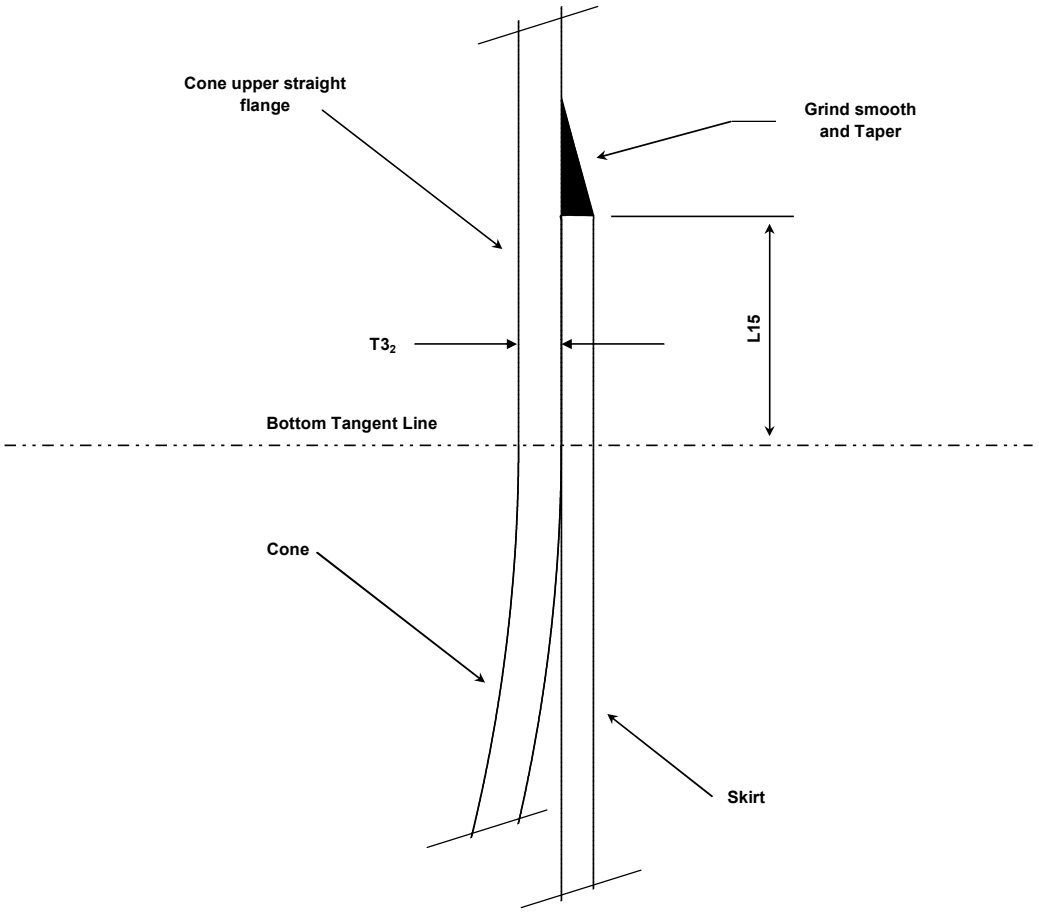
3.9. **Skirt to Cone Weld Detail – In Line Skirt**

Skirt to Cone Weld Detail

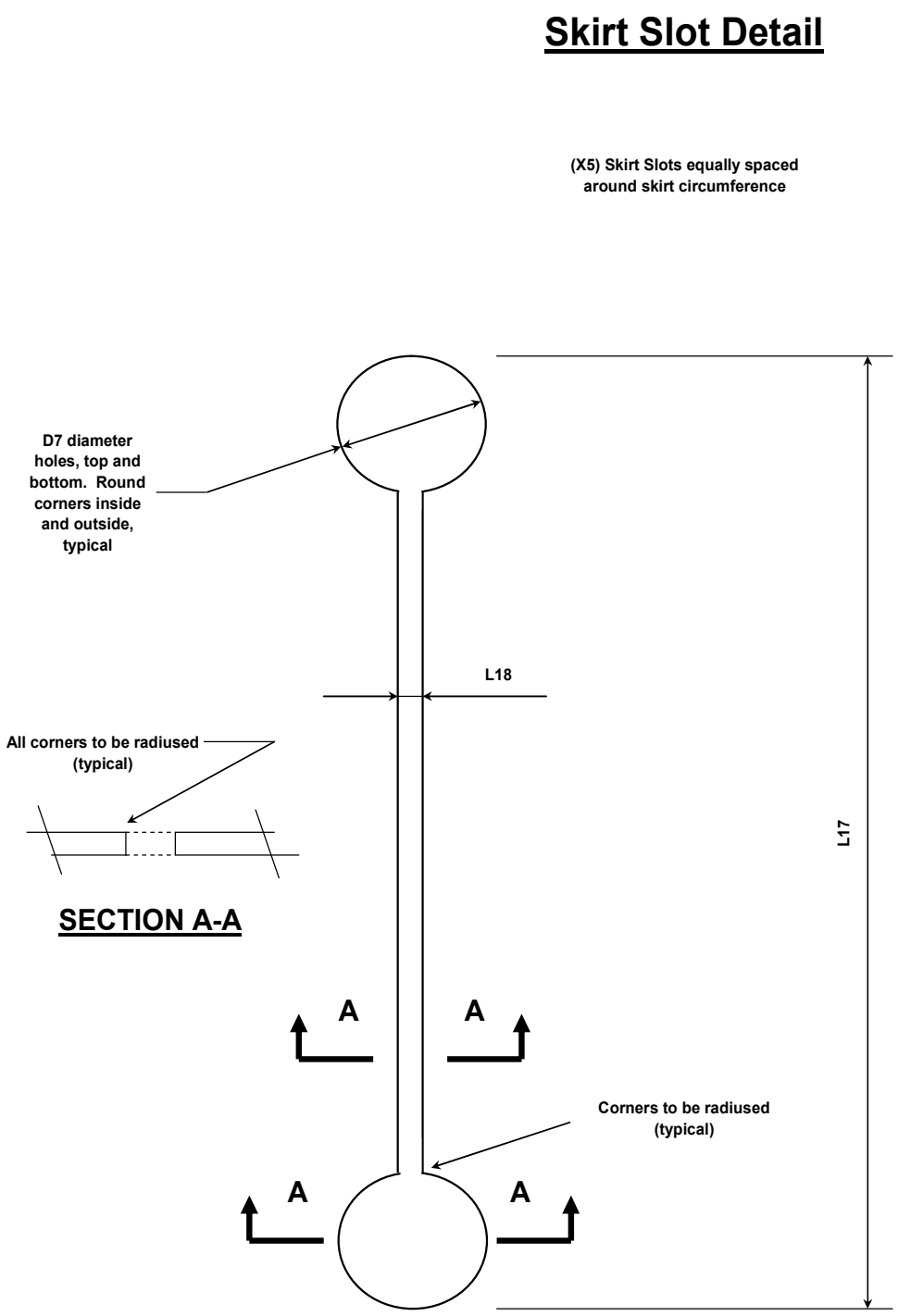


3.10. **Skirt to Cone Weld Detail – Overlapping Skirt**

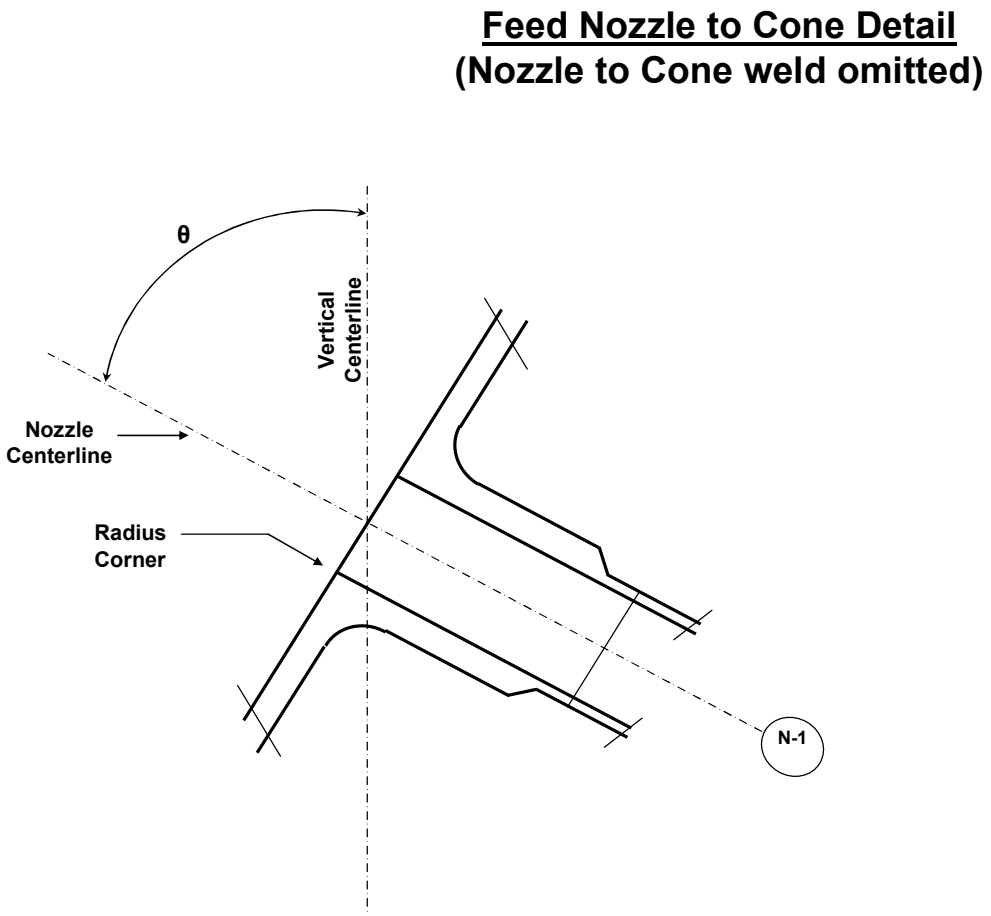
Skirt to Cone Weld Detail
(Shell to Cone weld omitted)



3.11. **Skirt Slot Detail**

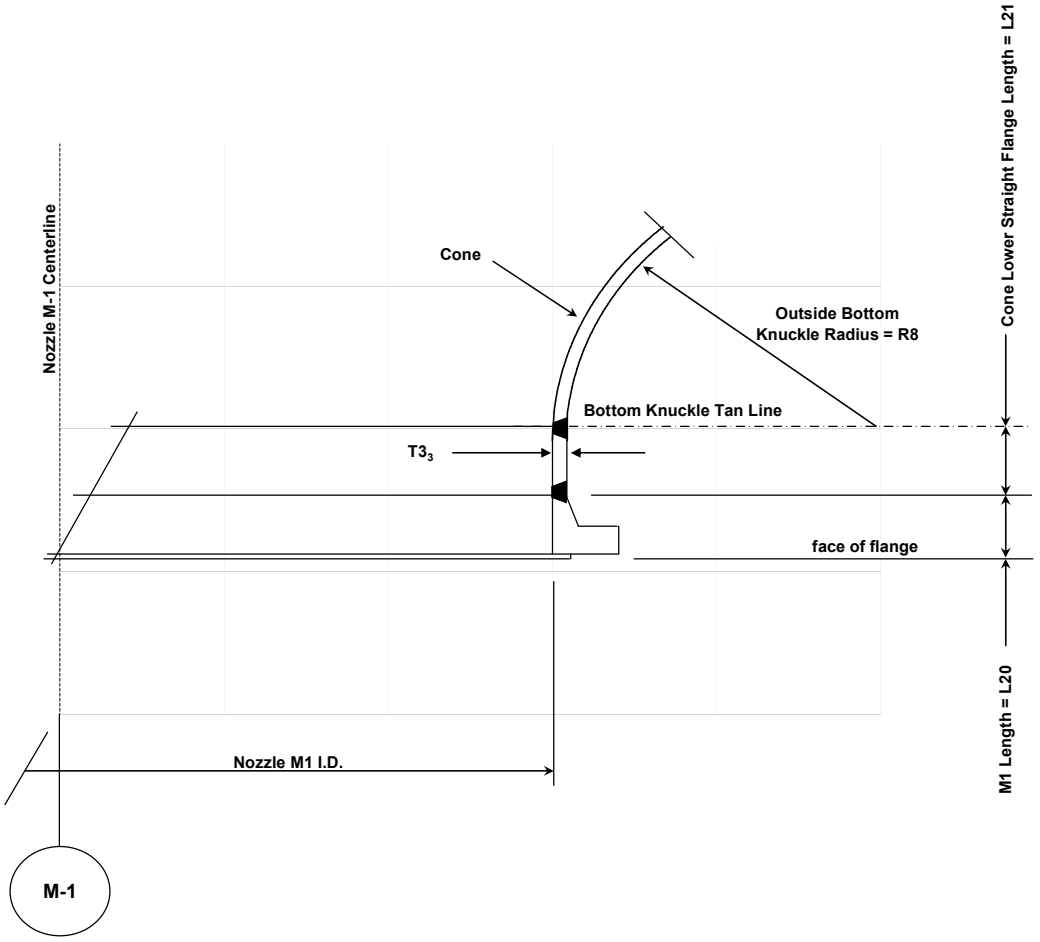


3.12. **Feed Nozzle to Cone Detail**



3.13. **Bottom Cone Detail**

Bottom Cone Detail



4. OPERATING CONDITIONS

4.1. **Operating Pressure,** maximum at top: _____psig

4.2. **Operating Temperature**, maximum: at Top : _____^{O}F

at Bottom: _____^{O}F

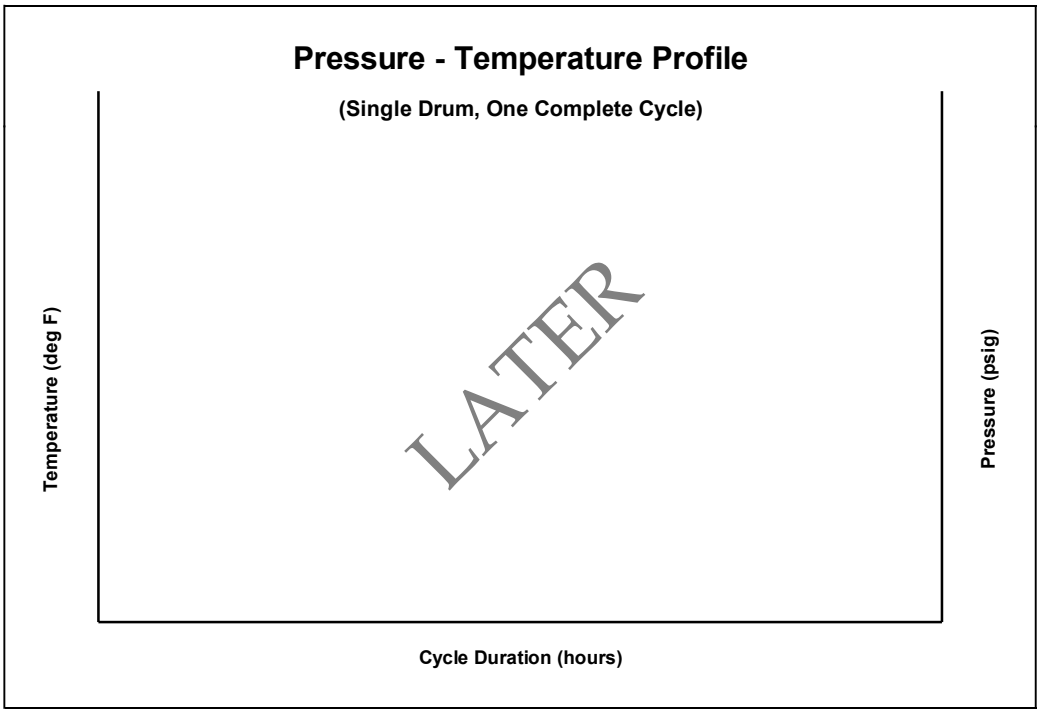
4.3. **Operating Conditions -** Coke drums operate on a **X2** hour cycle (that is, preheat–steam, preheat-hot vapor, coking, steam stripping, water quench, drain, drill, decoke, rehead, purge, and test; see Pressure-Temperature Profile, below.

4.4. **Pressure-Temperature Profile**

4.4.1. **Tabulation**

COKING CYCLE **PRESSURE-TEMPERATURE PROFILE TABLE**					
Sequence	**Duration** (hours)	**Initial Temp.** (^{O}F)	**Final Temp.** (^{O}F)	**Initial Press.** (psig)	**Final Press.** (psig)
Steam Preheat					
Vapor Preheat					
Coking					
Steam Stripping					
Water Quench					
Drain					
Drill					
Decoking					
Rehead					
Steam Purge					
Test					
CYCLE TOTAL		Total Cycle Time, **X2** (see Para. 3.5.1)			

4.4.2. **Graph**



4.5. _____

4.6. _____

5. DESIGN CONDITIONS

5.1. **Design Pressure:** at top flange: _____psig

at _____: _____psig

at _____: _____psig

at feed nozzle: _____psig

5.2. **Design Temperature:** at _____: _____^{O}F

at _____: _____^{O}F

at _____: _____^{O}F

5.3. **Corrosion Allowance,** see Para. 3.5.6 and 9.4**:**

Head _____

Shell _____

Cone _____

Nozzles _____

5.4. **External Design Pressure:** _____psig at _____°F

5.5. **Minimum Design Metal Temperature:** _____°F

5.6. **Coking**

- Coke density: _____
- Coke level: equal to **L10**
- _____

5.7. **Quenching**

- Coke and water density: _____
- Coke and water level: equal to **L10**
- Quench design temperature: _____°F
- _____

5.8. **Wind:**

- Design Code: _____
- Wind Speed: _____
- Exposure: _____
- _____

5.9. **Seismic:**

- Design Code: _____
- Zone: _____
- _____
- _____

5.10. **Radiography: Full**

5.11. **Joint Efficiency: 100%**

5.12. **Design Conditions:**

5.12.1. A uniform shell thickness is considered to be current best practice is coke drum design, but should stepped shell thickness be specified or allowed, the number of shell thicknesses should be minimized.

5.12.2. Deheading device (bottom and/or top) supports are not to be welded to the drum shell or heads.

5.12.3. Bottom deheading device weight to be supported by drum table top only; no additional loads on drum are to be imposed by deheading device.

5.12.4. _____

5.12.5. _____

5.12.6. Concurrent Design Conditions – All concurrent design conditions are to be calculated, see table below.

5.12.7. Supplier/Fabricator to design, provide calculations, and detail drawings in accordance the Concurrent Design Conditions.

5.12.8. Supplier/Fabricator to provide shipping and loading diagram.

5.12.9. Supplier/Fabricator to design, provide calculations, detail drawings, and supply temporary hydrotest/shipping saddles, lifting lug, and tailing beam.

5.12.10. Tabulation - Concurrent Design Conditions, also see Design Pressure – Temperature Profile, paragraph 4.4.

5.12.10..1. Design Case 1 – Wind at design pressure and design temperature, operating at the beginning of the P-T profile's coking segment (that is, no coke load), and with all other applicable external loads.

5.12.10..2. Design Case 2 – Seismic at design pressure and design temperature, operating at the beginning of the P-T profile's coking segment (that is, no coke load), and with all other applicable external loads.

5.12.10..3. Design Case 3 – Wind at design pressure and design temperature, operating at the end of the P-T profile's coking

segment (that is, full of coke to specified level, **L10**), and with all other applicable external loads.

5.12.10..4. Design Case 4 – Seismic at design pressure and design temperature, operating at the end of the P-T profile's coking segment (that is, full of coke to specified level, **L10**), and with all other applicable external loads.

5.12.10..5. Design Case 5 – Wind, depressured at minimum expected temperature, at the end of the P-T profile's water quench segment (that is, full of coke and water to specified level, **L10**), and with all other applicable external loads.

5.12.10..6. Design Case 6 – Seismic, depressured at minimum expected temperature, at the end of the P-T profile's water quench segment (that is, full of coke and water to specified level, **L10**), and with all other applicable external loads.

5.12.10..7. Design Case 7 – Wind, external pressure at minimum expected temperature, at the beginning of the P-T profile's unhead, drain segment (that is, full of coke and water to specified level, **L10**), and with all other applicable external loads.

5.12.10..8. Design Case 8 – Seismic, external pressure at minimum expected temperature, at the beginning of the P-T profile's unhead, drain segment (that is, full of coke and water to specified level, **L10**), and with all other applicable external loads.

5.12.10..9. Possible Design Case – Pre-maintenance steam out, external pressure at minimum expected temperature, no coke or water load, with applicable external loads.

5.12.10..10. Possible Design Case (if shop fabricated) – hydrotest pressure, full of water, at ambient temperature, in horizontal position.

5.12.10..11. Possible Design Case (if field fabricated) – hydrotest pressure, full of water, at ambient temperature, in vertical position, neither wind nor seismic load.

5.12.10..12. Possible Design Case – Future field hydrotest (for shop fabricated drum) following field maintenance - hydrotest pressure, full of water, at ambient temperature, in vertical position, neither wind nor seismic load.

5.12.10..13. Possible Design Case (if shop fabricated) – shipping dynamic loads, depends on modes of shipping.

5.12.10..14. Possible Design Case (if shop fabricated) – initial lift from horizontal position.

5.12.10..15. Possible Design Case (if shop fabricated) – final lift in vertical position.

5.12.10..16. Other Possible Design Case(s) to be evaluated based on anticipated design conditions.

5.12.10..17. Design Cases Tabulated

Design Condition		Para.	Design Cases											
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Design	Design Pressure	5.1	X	X	X	X								
	Design Temperature	5.2	X	X	X	X	min	min	min	min				
	Corrosion Allowance	5.3	X	X	X	X	X	X	X	X				
	External Des. Pressure	5.4							X	X				
	Other													
Coking	Coke @ level **L10**	5.6			X	X								
	Other													
Quenching	Coke & Water @ level **L10**	5.7					X	X	X	X				
	Other													
External	Wind	5.8	X		X		X		X					
	Seismic	5.9		X		X		X		X				
	Other													
Hydrotest	New (horizontal – shop fabricated)	7.												
	New (vertical – field fabricated)	7.												
	Future (vertical)	7.												
	Other													
Lifting/Shipping	Horizontal - Shipping	17.												
	Initial Lift - Horizontal	17.												
	Final Lift - Vertical	17.												
	Other													

5.13. **Finite Element Analysis (FEA):**

5.13.1. FEA is to be performed by others on cone/shell/skirt junction, including all concurrent loads, as a minimum. Any adjustments or changes will be provided immediately to drum Supplier/Fabricator.

5.13.2. Each drum is cycled through the attached Design Pressure-Temperature Profile.

5.13.3. The cone/shell/skirt junction is expected to be in-service **X3** years before shutdown for major repairs.

5.13.4. To meet the cone/shell/skirt junction design criteria, above, the following dimensions and quantities may be considered as variables. Prior approval of Owner/Engineer is required.

- Alternate cone/shell/skirt junction designs
- Number of skirt slots
- Skirt slot hole diameter
- Skirt slot length
- Skirt slot width
- Skirt slot distance from bottom tangent line
- Skirt thickness
- Inside top knuckle radius
- Inside (weld) junction radius
- Hot box distance from bottom tangent line
- Insulation detail
- Fireproofing detail
- _____

5.13.5. _____

5.13.6. _____

6. MAXIMUM ALLOWABLE WORKING PRESSURE:

_____psig

Limited by _____

7. **HYDROTEST PRESSURE:** Horizontal (shop) _____psig

Vertical (field) _____psig

Future Field _____psig

8. **WEIGHTS**

8.1. **Fabrication:** _____

8.2. **Shipping:** _____

8.3. **Operating (Coking):** _____

8.4. **Operating (Quench):** _____

8.5. **Field Hydrotest:** _____

8.6. _____

9. **MATERIALS**

9.1. **Head:** _____

9.2. **Shell:** _____

9.3. **Cone:** _____

9.4. **Clad:** _____

(See Para. 3.5.6 and 5.3)

9.5. **Nozzles:** _____

9.6. **Flanges:** _____

9.7. **Pipe:** _____

9.8. **Fittings:** _____

9.9. **Skirt:** _____

9.10. **Weld Metal, base material:** _____

9.11. **Weld Metal, clad material:** _____

9.12. **Weld Metal, overlay material:** _____

9.13. **Hot Box Ring:** _____

9.14. **Baseplate:** _____

9.15. **Lifting Supports:** _____

9.16. **Insulation Studs:** _____

9.17. **Insulation Supports:** _____

9.18. **Nuts:** _____

9.19. **Bolts:** _____

9.20. **Gaskets:** _____

9.21. **Other:** _____

9.22. **Plate Material Purchase Requirements –**

9.22.1. Material is to be purchased to meet the following additional requirements.

- Clad plate to be purchased in accordance with ASME Material Specification SA-263, Specification for Stainless Chromium Steel-Clad Plate.
- The Watanabe J Factor is to be calculated for plate material and is to be less than 150.
- Plate material is to be purchased with the following maximum trace components:

  Sulfur _____%

  Phosphorus _____%
- _____

9.22.2. Plate material is to be purchased to meet the following additional requirements in accordance with ASME Material Specification SA-20, Specification for General Requirements for Steel Plate for Pressure Vessels.

- S1 Vacuum Treatment
- S2 Product Analysis
- S3 Simulated Post-Weld Heat Treatment of Mechanical Test Coupons
- S5 Charpy V-Notch Impact Test
  - Orientation of test specimens are to be: _____ (Longitudinal and/or Transverse)
  - Temperature, if other than SA-20, paragraph 12.1 _____ °F
  - Acceptance criteria, if other than SA-20, paragraph 12.1
  - _____
- S7 High Temperature Tension Tests
- S9 Magnetic Particle Examination
- Ultrasonic Testing (Specify which applies)

- S8 Ultrasonic Examination in Accordance with A435 – Straight beam examination of Plain (unclad) plate
- S11 Ultrasonic Examination in Accordance with A577 – Angle beam examination
- S12 Ultrasonic Examination in Accordance with A578 – Straight beam examination of Plain and Clad Plate for Special Application
- _____

- _____

9.22.3. _____

9.22.4. Shell plate material is to be purchased to maximize the shell course length and to minimize the number of circumferential weld seams.

9.23. **Weld Material –**

9.23.1. It is current coke drum best practice for weld material yield strength to match base weld material yield strength as close as possible.

9.23.2. The Bruscato X Factor (X Bar) is to be calculated for weld material and is to be less than 15.

9.24. **Heat Treatment -**

9.24.1. Heat treatment is to be performed in accordance with ASME Section VIII, Division 1.

9.24.2. Material manufacturer to supply material based upon all heat treatment requirements including mill, fabrication, post weld heat treatment, and shop repairs, requirements, and two additional cycles in field.

9.24.3. All heat treatment is to be documented with time-temperature charts and provided to Owner/Engineer.

9.24.4. Where a possibility of deformation or distortion may occur during heat treatment, temporary reinforcing is to be provided.

9.24.5. _____

9.25. **Material Alternates -** Any material alternates or substitutes must be prior approved by Owner/Engineer in writing.

10. NOZZLES AND APPURTENANCES

10.1. Feed nozzle(s) to enter cone perpendicular to cone wall (feed enters drum angled up).

10.2. Bottom outlet/manway and top access/manway nozzle dimensions to be provided by top and bottom deheading device Supplier/Fabricator, if so equipped.

10.3. Vapor outlet nozzle and anti-foam nozzle to be oriented 180^{O} from each other.

10.4. All nozzles to be integrally reinforced (self-reinforcing) type and radiographable in accordance with ASME Section VIII, Division 1, Figure 16.1 (f-1 through f-4).

10.5. Reinforcing pads are not allowed.

10.6. No structural, piping, and/or electrical supports are to be welded to drum shell or heads.

10.7. Nozzle orientations are to be in accordance with the attached nozzle orientation detail.

10.8. Level detector attachments are to be in accordance with the attached level detector details.

10.9. Insulation support details are to be in accordance with the attached insulation details.

10.10. Fireproofing support details are to be in accordance with the attached fireproofing details.

10.11. Grounding lugs (2) are to be in accordance with the attached ground lug detail.

10.12. _____

11. FABRICATION

11.1. Shell sections to be fabricated using maximum available width plate or other techniques to minimize the number of circumferential weld seams.

11.2. Unequal wall thicknesses, if specified or allowed, are to be tapered on the vessel exterior, ground flush and smooth to a minimum 10:1 taper.

11.3. Shell out-of roundness tolerances are to be well within Code requirements.

11.4. All temporary fabrication attachments should be minimized.

11.5. All corners, edges, immediate direction changes, etc. are to be radiused, ground flush and smooth, or otherwise eased to eliminate stress concentrations.

11.6. All nozzles are to be flush and smooth with the inside drum surface.

11.7. Bolt holes (nozzle and anchor bolts) are to straddle natural centerlines, vertical, horizontal, and north-south, east-west.

11.8. All nozzle projections are to the face of flange.

11.9. If the coke drum is a replacement for an existing drum and the base plate is also to be replaced, then the existing anchor bolts locations are to be surveyed and this survey provided to the vessel Supplier/Fabricator.

11.10. _____

12. WELDING

12.1. All welding is to be performed in accordance with ASME Section VIII, Division 1, Section II, and Section IX.

12.2. Welding procedure specifications (WPS) and procedure qualification records (PQR) must be prior approved by Owner/Engineer in writing.

12.3. Welder performance qualification records are to be made available for Owner/Engineer review.

12.4. Applicable welding procedure and preheating requirements for each weld are to be shown on Supplier/Fabricator's drawings.

12.5. All pressure containing welds are to be double welded, full penetration welds, and ground flush and smooth.

12.6. All double welded connection's root passes are to be chipped, gouged, and/or ground to sound metal prior to back welding.

12.7. All double welded connection root passes which cannot be chipped, gouged, and/or ground are to made using Gas Tungsten (GTAW) weld process.

12.8. Weld joint alignment tolerances are to be well within Code requirements.

12.9. Clad restoration welding and all weld overlay is to be applied by a minimum of two passes.

12.10. Nozzle and appurtenance welds are to be located such that nozzle and appurtenance weld heat affected zones (HAZ) and circumferential and longitudinal HAZ do not overlap.

12.11. All nozzle necks and flange faces to be clad or weld overlaid with material matching clad material.

12.12. Preheat requirements are to be in accordance with ASME Section VIII, Division 1 and preheat temperature is to be maintained until the weld is completed.

12.13. All welds are to be free of undercutting.

12.14. All non-pressure containing welds are to be full penetration, if possible, radiused, and ground flush and smooth.

12.15. Upon removal all temporary fabrication attachment welds to be repaired, ground flush and smooth.

12.16. All corners, edges, and immediate direction changes are to be radiused, ground, or otherwise eased to eliminate stress concentrations.

12.17. No welding is to be performed on the coke drum after Post Weld Heat Treatment unless prior approved by Owner/Engineer in writing.

12.18. _____

13. POST WELD HEAT TREATMENT

13.1. Heat treatment is to be performed in accordance with ASME Section VIII, Division 1.

13.2. All heat treatment, whether intermediate stress relief, post weld heat treatment, or local post weld heat treatment, is to be documented with time-temperature charts and provided to Owner/Engineer.

13.3. Where a possibility of deformation or distortion may occur during heat treatment, temporary reinforcing is to be provided.

13.4. Flange gasket surfaces are to be protected from excessive oxidation during heat treatment.

14. INSPECTION AND TESTING

14.1. **Tolerances –** Minimum acceptable fabrication tolerances are to be in accordance with ASME Section VIII, Division 1 and as shown on the attached detail drawing.

14.2. **Drawing Requirements -** Applicable nondestructive testing procedures for each weld and component are to be shown on Supplier/Fabricator's drawings.

14.3. **Testing Personnel -** Testing personnel are to be qualified in accordance with American Society of Nondestructive Testing recommended practice SNT-TC-1A.

14.4. **Positive Material Identification (PMI)**

14.4.1. All alloy materials (plate, clad, overlay, forgings, pipe, fittings, flanges, supports, bolts, gaskets, weld metal, etc.) are to be positive material identified as a minimum upon completion of post weld heat treatment.

14.4.2. Standard methods of analysis listed in ASTM A751 are acceptable and with instruments and methods capable of quantitative measurement of major alloying elements.

14.4.3. All materials are to comply with the applicable ASME Section II material specifications as to alloy content and percentage content must fall within specified ranges.

14.4.4. _____

14.5. **Radiographic examination (RT)**

14.5.1. All welds are to be 100% radiographically tested as a minimum upon completion of post weld heat treatment.

14.5.2. Radiographic examination is to be performed in accordance with ASME Section VIII, Division 1 and Section V.

14.5.3. _____

14.6. **Ultrasonic examination (UT)**

14.6.1. All clad material is to be ultrasonically tested for lack of bonding after forming.

14.6.2. All clad plate is to be 100% ultrasonically tested as a minimum upon completion of post weld heat treatment.

14.6.3. Ultrasonic examination is to be performed in accordance with ASME Section VIII, Division 1 and Section V.

14.6.4. _____

14.7. **Magnetic particle (MT)**

14.7.1. All welds are to be 100% magnetic particle tested as a minimum upon completion of post weld heat treatment.

14.7.2. Magnetic particle examination is to be performed in accordance with ASME Section VIII, Division 1 and Section V.

14.7.3. _____

14.8. **Liquid penetrant (PT)**

14.8.1. All attachment welds, temporary fabrication attachment welds, overlay welds, and weld repairs are to be liquid penetrant tested upon completion of post weld heat treatment.

14.8.2. Liquid penetrant examination is to be performed in accordance with ASME Section VIII and Section V.

14.8.3. _____

14.9. **Brinell hardness (BHN)**

14.9.1. All pressure containing welds, heat affected zone (HAZ), and base metal on either side of the weld are to be Brinell hardness tested after post weld heat treatment.

14.9.2. The maximum acceptable reading is to be 225 BHN.

14.9.3. The defined locations for hardness testing are every ten feet of each longitudinal weld and each circumferential weld, all nozzle attachment welds, and additional locations or frequencies may be requested by Owner representative.

14.9.4. _____

14.10. **Hydrotest**

14.10.1. Hydrostatic testing is to be performed in accordance with ASME Section VIII, Division 1.

14.10.2. Test gaskets material and type are to be as specified above.

14.10.3. Clad drums are to be tested with water limited to 100 ppm chloride content.

14.10.4. Test water temperature is not to be less than 60 °F.

14.10.5. _____

15. SURFACE PREPARATION AND PAINT

15.1. Surface preparation, priming, and painting are to be in accordance with the attached specification.

15.2. All external surfaces not insulated are to be sandblasted, primed, and coated.

15.3. Flange faces are not to be sandblasted and coated.

15.4. _____

16. INSULATION AND FIREPROOFING

16.1. Insulation and fireproofing are to be in accordance with the attached detail drawings.

16.2. Insulation around the cone/shell/skirt junction and shell welds is to be removable to aid inspection.

16.3. Insulation support rings are not to be welded to the head, shell, or cone.

16.4. Insulation support technique is to minimize local stress and through shell wall cracking.

16.5. Additional personnel protection insulation is to be installed where necessary.

16.6. _____

17. SHIPPING AND LIFTING

17.1. Shipping and lifting supports and devices design, details, and supply are to be provided by Supplier/Fabricator.

17.2. Lifting and tailing devices are to be designed with an impact factor of 1.5.

17.3. Lifting support connections to drum shell and/or head to minimize local stresses and through wall cracking.

17.4. Supplier/Fabricator to load, adequately tie down, and secure the equipment for shipping.

17.5. If the drums are shipped over salt water the Supplier/Fabricator is to provide all necessary shipping preparations, including all closures.

17.6. Spare gaskets for each nozzle are to be shipped with drum by Supplier/Fabricator.

17.7. _____

18. ORDER OF PRECEDENCE

18.1. The order of precedence should there be a conflict between or among any of the codes, specifications, drawings, documents, purchase order, etc. shall be: the applicable code, this specification, Owner/Engineer provided drawings and documents, and Owner/Engineer reviewed drawings and documents.

18.2. If there is any doubt as to requirements, Supplier/Fabricator is to request clarifications, in writing, from the Owner/Engineer, who will respond in writing.

18.3. _____

19. REFERENCE DRAWINGS AND STANDARDS

19.1. Level Detector Details

19.2. Insulation Details

19.3. Fireproofing Details

19.4. Grounding Lug Detail

19.5. Minimum Acceptable Fabrication Tolerances

19.6. Surface Preparation and Painting Specification

19.7. _____

19.8. _____

19.9. _____

19.10. _____

19.11. _____

19.12. _____

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19.19. _____

19.20. _____