BHTS
Bechtel Hydrocarbon Technology Solutions, Inc.

Coke Drum Improvements – Real World Reliability

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Introduction

- Industry leading robust mechanical design.
- Coke drums are subject to cyclic loading through thermal cycling and interaction with insitu coke.
- Avoid premature bulging & shell cracks.

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- **Achieving Excellent Coke Drum Longevity – Four Key Factors**
  - Design / Specification
  - Fabrication
  - Inspection
  - Ongoing Operational / Mechanical life management

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- **Design / Specification**
  - Shell wall thickness
    - Real World measured drum response to analyze cyclic loading.
    - Practical and Proven Correlations for shell thickness
    - Uniform

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- **Design / Specification**
  - Reduced number of circumferential welds
    - Taller shell courses
    - Vertical panel construction

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- **Design / Specification**
  - Coke Drum Customized plate specification
    - Higher Strength 1 Cr or 1 ¼ Cr plate
      - With Improved plate property requirements
    - Avoid 2 ¼ Cr or Vanadium enhanced steels
    - Higher clad shear bond strength

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- **Design / Specification**
  - Nozzle Design
    - Fully inspectable integrally reinforced nozzles.
      - Code figure UW 16.1f
    - Recognize and apply all real world loads to design.

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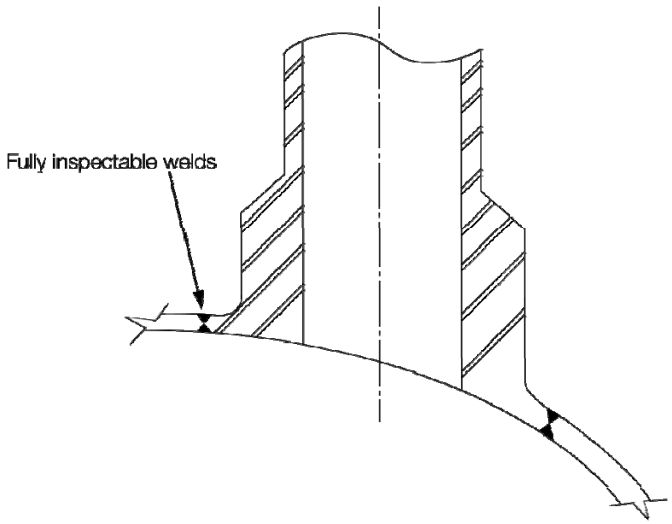
Integrally Reinforced Nozzle
As per Figure UW-16.1f in ASME Section VIII Division I



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- **Design / Specification**
  - Two generally used types of skirt attachments
    - In-Line and Tangent Mount.
    - Finite element analysis based on real-world strain and thermal transients.
    - No skirt design is perfect.

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- **Design / Specification**
  - In-Line skirts
    - Satisfyingly straight forward computational solution.
    - Disadvantage in heat transfer to and from cone to skirt.
    - Special case forged ring design.

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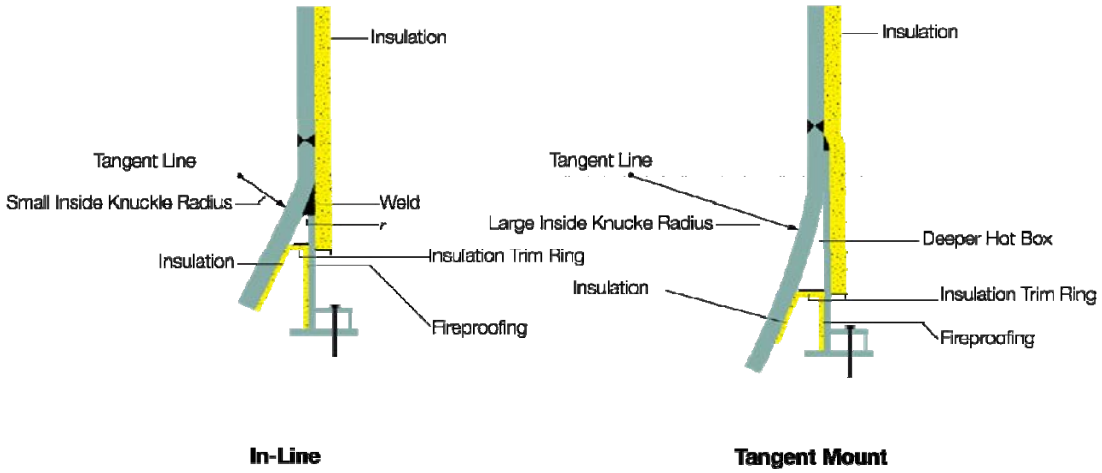

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- **Design / Specification**
  - Tangent Mount skirts
    - Issue of the ‘singularity’.
    - Rigorous fabrication.
    - Significantly better heat transfer to and from cone.

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- **Fabrication**
  - Rigorous qualification method for fabricators.
  - Very tight fabrication tolerances.
  - Fatigue resistant weld design.

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- **Inspection and Testing**
  - Tighter than code Radiographic acceptance criteria.
  - UT in lieu of RT requirements.
  - Fabrication tolerance assurance.

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- **Ongoing Operational / Mechanical fatigue management.**
  - Strain Gages and Drum Skin TIs
  - Statistically Significant number of observations vs operation variables.
    - Reach operational goals without undue fatigue accumulation.
    - Make informed decisions on drum life management.

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- **Overcoming Complications with side feed entry nozzles.**
  - Flow channeling and heat maldistribution
    - Uneven coking, inefficient quenching.
    - Hot spots, blowouts.

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- **Overcoming Complications with side feed entry nozzles.**
  - Some cokers seem to ‘get by’ with single feed entry
  - Some cokers do not.
  - Key is to simulate bottom center up flow as much as practical.

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- **Overcoming Complications with side feed entry nozzles.**
  - Computational Fluid Dynamics (CFD).
    - Recommend upward swept dual flow.
    - Importance of feed piping configuration.
  - Piping design to support operations.

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