
N693: Casing Design and Well Integrity Engineering

Instructor(s): Kevin Gray

Format and Duration

Classroom - 5 Days

Summary

Casing design plays a fundamental role in ensuring well integrity throughout the well lifecycle—from drilling and completion to production and eventual abandonment. A well-structured casing design is critical for maintaining well stability, pressure containment, and operational safety.

This course provides a comprehensive understanding of casing design principles, focusing on engineering compliance with international well integrity standards such as API, ISO, and NORSOK. Participants will learn how to design casing programs based on geomechanics, wellbore pressure profiles, material selection, and stress analysis. This course can be delivered at an Foundation or Skilled level, depending on the audience's experience and technical requirements.

This course is delivered in partnership with Black Reiver Consulting Ltd.

Learning Outcomes

Participants will learn how to:

1. Understand and apply well integrity standards (API, ISO, NORSOK) to casing design.
2. Analyse pressure profiles and stress loads to optimize casing seat selection.
3. Calculate casing loads and assess triaxial stress conditions for wellbore integrity.
4. Evaluate casing wear, collapse resistance, and tensile strength under different well conditions.
5. Understand the basis of corrosion in OCTG products
6. Select appropriate casing materials, corrosion resistant alloys (CRAs), and thread connections.
7. Implement proper procurement, inspection, and running procedures for casing strings.
8. Apply well integrity principles throughout the entire well lifecycle.

Training Method

This is a classroom course comprising a mixture of lectures, discussion, case studies, and practical exercises.

- Hands on calculations and case studies using industry standard formulas and design tools.
- Step by step explanations of casing selection, load cases, and well integrity engineering.
- Instructor led sessions combining PowerPoint, whiteboard explanations, and group exercises.
- Interactive discussions and Q&A sessions to clarify complex engineering concepts.
- Real-world scenarios to demonstrate common casing design challenges and solutions.

Who Should Attend

This course is ideal for:

- Drilling Engineers, Wellsite Supervisors, Tool Pushers, and Rig Managers involved in casing selection

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and installation.

- Geoscientists & Reservoir Engineers looking to better understand well integrity and casing constraints.
- Field Support Personnel & Well Integrity Engineers working on wellbore stability and casing design optimization.
- Anyone responsible for ensuring well integrity in drilling operations.

Course Content

1. Well Integrity & Casing Design Fundamentals

- OCTG tubular manufacturing and testing.
- Well Integrity Standards – API, ISO, and NORSOK compliance.
- Testing & Documentation – Verifying casing performance and life of well integrity.
- Conventional Casing Design Approach
- Pressure integrity and casing seat selection.
- Pore pressure & fracture gradient curves.
- Mud weight window & kick tolerance considerations.

2. Modified Casing Design Considerations

- Geomechanics, collapse gradient, and stress conditions.
- XLOT minimum stress values and leakoff tests.
- Directional well considerations and tortuosity effects.

3. Forces Acting on Casing Strings

- Uni-axial, bi-axial and tri-axial casing loads.
- WME envelope and using it to design within a safe operational envelope.
- Buoyancy, cementing effects, and axial load variations.
- Pressure testing and stuck pipe influences on casing selection.
- Practical Exercise: Basic casing seat depth design.

4. Casing Load Cases & Stress Analysis

- Understanding Load Cases in Casing Design
- Basics of stress and strain in casing materials.
- Uniaxial, biaxial, and triaxial stress conditions.
- Von Mises Equivalent (VME) Envelope
- Constructing VME envelopes for casing analysis.
- Design Factors & Safety Margins
- ISO and API standard safety factors.
- Casing Wear & Derating Factors

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- Thermal effects on casing performance.
- Casing wear models and monitoring techniques.
- Practical Exercise: Evaluating casing collapse, burst, and tensile strength.

5. Steel Properties, Manufacturing & Failure Mechanisms

- API & ISO Standards for Casing Materials
- Chemical & physical properties of steel.
- Manufacturing processes for Oil Country Tubular Goods (OCTG).
- Post Manufacturing Treatments & Effects
- Normalization, quenching, and cold treatments.
- QA/QC & Mill Certification
- Steel testing requirements and mill documentation.
- Casing Failure Mechanisms
- Tensile failure – brittle, ductile, and creep.
- Burst failure & collapse failure modes.
- Torsional and compression induced buckling.
- Practical Exercise: Assessing casing failure risks and selecting appropriate safety factors.

6. Geological & Corrosion Considerations in Casing Design

- Geological Impacts on Casing Design
- Casing seat placement in different formations.
- Challenges with salts, squeezing shales, and fluid migration.
- Corrosion Mechanisms in Casing Materials
- Sweet (CO₂) corrosion and sour (H₂S) corrosion.
- Stress corrosion cracking and microbial corrosion risks.
- Corrosion Resistant Alloys (CRA) & Material Selection
- CRA selection for CO₂ and H₂S environments.
- Combined CO₂/H₂S considerations for casing durability.
- Casing Connections & Thread Forms
- API vs. proprietary connection designs.
- Thread leak resistance & torque makeup considerations.
- Practical Exercise: Selecting casing materials based on environmental conditions.

7. Casing Procurement, Inspection & Running Procedures

- Casing & Tubing Procurement Best Practices
- QA/QC requirements for casing materials.
- Nonstandard tubular lead times and supplier selection.
- Storage & Transport of Casing Strings
- CRA handling considerations and supply chain awareness.
- Casing Inspection & Rigsite Preparation

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- API inspection levels and selection criteria.
- Rigsite casing handling and preparation for running.
- Casing Running Procedures & Wellhead Considerations
- Float shoe selection & cement placement strategies.
- Wellhead growth & tension loading considerations.
- Hanger design and load verification.
- Practical Exercise: Planning a casing running procedure and risk assessment.

This course provides a comprehensive, practical approach to casing design and well integrity. With a strong engineering and operational focus, participants will acquire the skills and confidence to design casing programs that enhance well safety, integrity, and performance. Participants will be equipped with the knowledge and tools to design and optimize casing programs, ensuring well integrity, safety, and cost efficiency.