



N688: Drillstring Design

Instructor(s): Kevin Gray

Format and Duration

Classroom - 5 Days

Summary

This course provides an in depth understanding of drillstring design, operation, and inspection, essential for well construction professionals. It starts with foundational concepts, including drillstring metallurgy and component selection, then progresses to the mechanical forces acting on the drillstring during operations.

Key design considerations for low angle wells will be covered before expanding into Torque & Drag (T&D) mechanics and the modifications needed in the Bottom Hole Assembly (BHA) as well inclination increases. The course also tackles environmental factors such as shock, vibration, erosion, and corrosion, integrating them into the design and operational decision making process.

Additional topics will focus on advanced drillstring mechanics, hydraulics, wear and fatigue management, safety best practices, Realtime monitoring, and emergency troubleshooting to provide a comprehensive understanding of drillstring performance and reliability. This is a across level course designed for Introductory learners and Higher Level Refreshers.

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

Learning Outcomes

Participants will learn how to:

1. Understand the fundamental considerations in drillstring design for low and high-angle wells.
2. Analyse torque and drag origins and their implications for well and drillstring design.
3. Identify and mitigate causes of drillstring failure, including shock, vibration, erosion, and corrosion.
4. Select appropriate metallurgy and components based on operational needs.
5. Understand drillstring inspection, storage, and handling requirements to maximize service life.
6. Design drillstrings to minimize rotary tendency and improve hole cleaning efficiency.
7. Evaluate drillstring stresses in stuck pipe scenarios and loss of endpoint buoyancy considerations.
8. Assess axial, torsional, and bending loads on the drillstring and apply fatigue management strategies.
9. Understand drillstring hydraulics, including pressure loss, hole cleaning efficiency, and mud rheology effects.
10. Recognize best practices for Realtime monitoring of drillstring integrity and performance.
11. Apply troubleshooting techniques for common drillstring problems, including differential sticking, mechanical sticking, and hole collapse.

Training Method

This course ensures effective learning and retention through a blend of interactive teaching methods:

- Instructor Led Learning – A mix of PowerPoint overviews, whiteboard explanations, use of BHA model kits and interactive exercises.



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- Interlinked Course Narrative – Each topic builds on the previous one for a structured learning journey.
- Classroom Engagement – Ample opportunities for class-led discussions and Q&A sessions.

Who Should Attend

This course is ideal for well construction professionals – both rig based and office based staff. Engineers involved in designing, inspecting, or operating drillstrings. Experienced personnel needing a refresher after two years since their last drillstring design course.

Course Content

1. Fundamentals of Drillstring Design

- Key principles and priorities in drillstring design.
- Material selection based on strength, flexibility, and wear resistance.
- Drillstring component overview: Drill pipe, HWDP, BHA, tool joints, stabilizers.

2. Drillstring Mechanics & Loading Conditions

- Axial, torsional, and bending loads and their effects on performance.
- Buckling considerations – Identifying sinusoidal and helical buckling risks.
- Fatigue management – Predicting and preventing cyclic loading failures.
- Drillstring elongation and stretch due to high tension loads.

3. Drillstring Design for Low and High Angle Wells

- Differences in design approach for low angle vs. high angle wells.
- Adjusting BHA configurations as wellbore inclination increases.
- Directional considerations and the impact of well trajectory.

4. Torque and Drag (T&D) in the Wellbore

- What is Torque & Drag? Understanding frictional forces in the drillstring.
- Identifying key torque and drag contributors and mitigation strategies.
- Lubrication, mechanical friction reduction, and BHA adjustments.

5. Drillstring Hydraulics & Pressure Considerations

- Pressure loss calculations in the drillstring and annulus.
- Drilling fluid effects – Impact of viscosity, density, and rheology.
- Hydraulic optimization for hole cleaning and pressure balance.

6. Drillstring Failure: Causes & Prevention



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- Common failure modes: Fatigue, twistoff, washouts, overtorquing, dogleg severity effects.
- Failure prevention through API standards and operational best practices.

7. Shock & Vibration: Impact on Drillstring Performance

- Types of vibration: Axial, lateral, and torsional (stickslip).
- Effects of shock and vibration on tool longevity and drilling efficiency.
- Vibration monitoring techniques for early detection of issues.

8. Wear & Fatigue Management in Drillstrings

- Tool joint wear – Prevention and maintenance techniques.
- Slip crushing and overtorquing issues.
- Hardbanding best practices to reduce wear.

9. Drillstring Storage, Handling & Inspection

- Best practices for storing, handling, and transporting drillstring components.
- API & DSI inspection standards for drill pipe integrity.

10. Rotary Tendency & Hole Cleaning Considerations

- Understanding rotary tendency and how to counteract undesirable directional effects.
- Designing drillstrings for optimal cuttings transport and wellbore stability.

11. Drillstring Stresses & Stuck Pipe Scenarios

- Stress analysis during stuck pipe incidents.
- The impact of endpoint buoyancy loss on drillstring design.

12. Safety & Best Practices for Drillstring Operations

- Connection makeup and torque control.
- Best practices for running and pulling drillstrings.
- Handling heavyweight drill pipe (HWDP) and collars safely.

13. Real-Time Monitoring & Data Interpretation

- Protecting the drillstring in operations
- Downhole data analysis – Using MWD and LWD tools.
- Torque & drag monitoring – Identifying early warning signs.

14. Troubleshooting Common Drillstring Issues



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- Designs to avoid differential sticking and mechanical sticking.
- Consideration to avoid pack-off scenarios.
- Fishing and recovery considerations.

By the end of this course, participants will gain a deep understanding of drillstring design principles and develop the ability to design, inspect, and optimize drillstrings effectively. With practical discussions, real-world case studies, and interactive learning, this course equips learners with the knowledge and confidence to make informed drilling decisions.