COURSE OVERVIEW DE0854
Drill Bits
(E-Learning Module)

Course Title
Drill Bits (E-Learning Module)

Course Reference
DE0854

Course Format & Compatibility
SCORM 1.2. Compatible with IE11, MS-Edge, Google Chrome, Windows, Linux, Unix, Android, IOS, iPadOS, macOS, iPhone, iPad & HarmonyOS (Huawei)

Course Duration
30 online contact hours
(3.0 CEUs/30 PDHs)

Course Description

This E-Learning course is designed to provide participants with a detailed and up-to-date overview of drill bits. It covers the wide variety of bit types; the roller cone bit features; the tungsten carbide insert design and product technology; the pressure compensation; the hydraulics system and Bit IADC codes; the PDC bits, fixed cutter bit styles and common terminology; the bit profile influence and back rake angle influence on performance; the cutters development and cutters influence on performance; the PDC terminology, features and the components of bit profile; and the drilling dynamics, vibrations and product lines.

Further, the course will also discuss the deep and shallow cone profiles as well as its advantages and disadvantages; the general application guidelines, soft information, harder information and drilling dynamics; the drill string vibration, axial vibration, lateral vibration and torsional vibrations; the rig geolograph and axial, lateral and torsional vibration remedies; the proper BHA design, restarting of Bit and the types of whirl; the downhole vibration tools, bit dull condition, mud type and additives; the roller reamers in BHA; the drill bit technology and roller bit selection process; and the compressive strength of the rock estimation.

During this course, participants will learn the engineering classification for "intact" rock; the opportunities for PDC drill bits and the potential PDC application; the economics of Bit applications, cost per foot (CPF) and bit selection process; the IADC code roller cone comparison chart and roller cone availability chart; the drilling fluids, hydraulics, hydrostatic pressure of water and drilling mud; the Pascal's law and fluid flow principles; the flow measurement and deformation of a fluid by simple shear; the pump pressure and the sum of system pressure losses; the calculation and optimization of hydraulics; the HHP theory and jet impact theory; the vortex nozzle analysis, technical approaches and CFD analysis of vortex nozzle; the flow pattern around bit and hole, modular nozzle design and operating procedures/parameters; the WOB and RPM optimization, drill-off tests, identification of problems and corrective actions; and the purpose of Bi-Center bit, BHA stabilization, BHA modelling for Critical RPM's and planning Bi-Center BHA runs.

Course Objectives

Upon the successful completion of this course, participants will be able to:-

- Apply and gain an in-depth knowledge on drill bits
- Recognize a wide variety of bit types including roller cone bits, fix cutter bits and specialty bits
- Identify roller cone bit features and describe cutting structure, bearings, hardfacing and seals
- Discuss tungsten carbide insert design, product technology, diamond tech2000 hardfacing, standard frame body, modular frame body and design as well as arm and shirttail design
- Ensure pressure compensation as well as describe grease reservoir, central ball race bearing, precision bearing "hard turn", bearing and seal system and stabilization pads
- Recognize hydraulics system and Bit IADC codes
- Identify PDC bits, fixed cutter bit styles, common terminology
- Explain bit profile, bit profile influence on performance and back rake angle influence on performance
- Describe cutters development and cutters influence on performance
- Discuss drilling dynamics, vibrations and product lines that include PDC and diamond bits
- Identify steel body, matrix body, dual diameter, impregnated with GHI's and fixed cutter bits
- Recognize PDC terminology and features as well as identify the components of bit profile
- Review deep and shallow cone profiles covering its advantages and disadvantages
- Determine nose radius and location from centerline
- Identify bit profile types, 4 general types, flat, short parabolic, medium parabolic and long parabolic
- Describe back rake angle, typical back rake angles, formation hardness, and design factors of back rake

- Determine the number of blades and PDC cutter size
- Discuss the general application guidelines, soft information, harder information and drilling dynamics
- Recognize drill string vibration, axial vibration, lateral vibration and torsional vibrations
- Illustrate rig geolograph and axial, lateral and torsional vibration remedies as well as change the drill string frequency
- Apply proper BHA design, restart the Bit and identify the types of whirl comprising of forward, backward and intermittent
- Identify downhole vibration tools, bit dull condition, mud type and additives and roller reamers in BHA
- Discuss drill bit technology as well as carryout drill bit and roller bit selection process
- Estimate compressive strength of the rock and classify engineering for “intact” rock
- Identify opportunities for PDC drill bits including the potential PDC application
- Discuss economics of Bit applications, cost per foot (CPF), bit selection process
- Recognize worn cutter, washed out bit, ring out, plugged nozzle, lost cutter, lost nozzle, lost matrix, junk damage and etc.
- Review IADC code roller cone comparison chart and roller cone availability chart that include insert bits and tooth bits
- Recognize drilling fluids and hydraulics as well as determine hydrostatic pressure of water and drilling mud
- Discuss Pascal’s law and fluid flow principles
- Measure flow and recognize deformation of a fluid by simple shear
- Illustrate fluid models, Newtonian, non-Newtonian, rotating sleeve viscometer or VG meter, stages of flow and bit pressure drop (psi)
- Determine pump pressure and the sum of system pressure losses
- Calculate and optimize hydraulics as well as identify bit hydraulic horsepower (BHHP) and jet impact force
- Discuss HHP theory and jet impact theory as well as differentiate max impact versus max bit HHP and bit HHP versus flow rate
- Carryout vortex nozzle analysis, technical approaches and CFD analysis of vortex nozzle
- Describe flow pattern around bit and hole, modular nozzle design and operating procedures/parameters
- Optimize WOB and RPM as well as employ drill-off tests, identification of problems and corrective actions
- Explain the purpose of Bi-Center bit, BHA stabilization, BHA modelling for Critical RPM’s and planning Bi-Center BHA runs

Who Should Attend

This course provides an overview of all significant aspects and considerations of drill bits for junior drilling engineers, junior well and operations engineers as well as other personnel involved in well planning and drilling.

Course Certificate(s)

Internationally recognized certificates will be issued to all participants of the course.

Certificate Accreditations

Certificates are accredited by the following international accreditation organizations: -

- The International Accreditors for Continuing Education and Training (IACET - USA)

  Haward Technology is an Authorized Training Provider by the International Accreditors for Continuing Education and Training (IACET), 2201 Cooperative Way, Suite 600, Herndon, VA 20171, USA. In obtaining this authority, Haward Technology has demonstrated that it complies with the **ANSI/IACET 1-2013 Standard** which is widely recognized as the standard of good practice internationally. As a result of our Authorized Provider membership status, Haward Technology is authorized to offer IACET CEUs for its programs that qualify under the **ANSI/IACET 1-2013 Standard**.

  Haward Technology's courses meet the professional certification and continuing education requirements for participants seeking **Continuing Education Units** (CEUs) in accordance with the rules & regulations of the International Accreditors for Continuing Education & Training (IACET). IACET is an international authority that evaluates programs according to strict, research-based criteria and guidelines. The CEU is an internationally accepted uniform unit of measurement in qualified courses of continuing education.

  Haward Technology Middle East will award **3.0 CEUs** (Continuing Education Units) or **30 PDHs** (Professional Development Hours) for participants who completed the total tuition hours of this program. One CEU is equivalent to ten Professional Development Hours (PDHs) or ten contact hours of the participation in and completion of Haward Technology programs. A permanent record of a participant's involvement and awarding of CEU will be maintained by Haward Technology. Haward Technology will provide a copy of the participant's CEU and PDH Transcript of Records upon request.

- British Accreditation Council (BAC)

  Haward Technology is accredited by the **British Accreditation Council** for **Independent Further and Higher Education** as an **International Centre**. BAC is the British accrediting body responsible for setting standards within independent further and higher education sector in the UK and overseas. As a BAC-accredited international centre, Haward Technology meets all of the international higher education criteria and standards set by BAC.

Training Methodology

This Trainee-centered course includes the following training methodologies:-

- Talking presentation Slides (ppt with audio)
- Simulation & Animation
- Exercises
- Videos
- Case Studies
- Gamification (learning through games)
- Quizzes, Pre-test & Post-test

Every section/module of the course ends up with a Quiz which must be passed by the trainee in order to move to the next section/module. A Post-test at the end of the course must be passed in order to get the online accredited certificate.

Course Fee

As per proposal

Course Contents

- Wide Variety of Bit Types
- Roller Cone Bits
- Fix Cutter Bits
- Specialty Bits
- Roller Cone Bit Features
- Cutting Structure
- Bearings
- Hardfacing
- Seals
- Tungsten Carbide Insert Design
- Product Technology
- Diamond Tech2000 Hardfacing
- Standard Frame Body
- Modular Frame Body
- Modular Frame Design
- Arm and Shirttail Design
- Pressure Compensation

- Grease Reservoir
- Central Ball Race Bearing
- Precision Bearing “Hard Turn”
- Bearing and Seal System
- Stabilization Pads
- Hydraulics System
- Bit IADC Codes
- Summary
- Introduction to PDC Bits
- Fixed Cutter Bit Styles
- Common Terminology
- Understanding Bit Profile, Bit Profile Influence on Performance, Back Rake Angle Influence on Performance
- Cutters Development, Cutters Influence on Performance
- Drilling Dynamics, Vibrations
- Product Lines: PDC Bits
- Steel Body
- Matrix Body
- Dual Diameter
- Product Lines: Diamond Bits
- Impregnated
- Impregnated with GHI’s
- Fixed Cutter Bits
- PDC Terminology & Features
- Components of Bit Profile
- Deep Cone Profiles: Advantages & Disadvantages
- Shallow Cone Profiles: Advantages & Disadvantages
- Nose Radius
- Location from Centerline
- Bit Profile Types
- 4 General Types
- Flat
- Short Parabolic
- Medium Parabolic

- Long Parabolic
- Back Rake Angle
- Typical Back Rake Angles
- Formation Hardness
- Design Factors – Back Rake
- Number of Blades
- PDC Cutter Size
- Cutter Size
- General Application Guidelines
- Soft Information
- Harder Information
- Drilling Dynamics – Vibrations
- Vibrations
- Drill String Vibration
- Axial Vibration
- Axial Vibration: Recognizing
- Rig Geolograph
- Visually/Audible
- Vibration Detection Sensors
- Axial Vibration: Remedies
- Change the Drill String Frequency
- Proper BHA Design
- Restart the Bit
- Lateral Vibration
- Lateral Vibrations: Types of Whirl
- Forward Whirl
- Backward Whirl
- Intermittent Whirl
- Lateral Vibrations: Hole Quality
- Whirling PDC Bit
- Non-Whirling PDC Bit
- Lateral Vibrations: Recognizing
- Nearly Impossible to See at Surface
- Downhole Vibration Tools

- Increasing the RPM Yields a Decrease in ROP
- Bit Dull Condition
- Lateral Vibrations: Remedy
- Restart the Bit
- Change Drilling Parameters to Prevent Whirl
- Use a Bit with Stabilizing Technology
- Increase Stabilization to BHA
- Torsional Vibration
- Torsional Vibration (Stick Slip)
- Torsional Vibration: Recognizing
- Surface Torque Gauges/Instruments
- Surface RPM
- Downhole Vibration Tools
- Torsional Vibration Remedies
- Increase RPM
- Decrease WOB
- Mud Type & Additives
- Roller Reamers in BHA
- Summary: Drill String Vibration
- Search for Stability Zone
- Drill Bit Technology: Drill Bit Selection
- Which Bit to Choose?
- Bit Selection Process Overview
- Selection Process
- Bit Selection Process – Details
- Estimating Compressive Strength of the Rock
- Engineering Classification for “Intact” Rock
- Roller Bit Selection Table
- Identify Opportunities for PDC Drill Bits
- Potential PDC Applications
- Identify Opportunities for Natural Diamond / Impregnated Drill Bits
- Economics of Bit Applications
- Cost per Foot (CPF)
- Bit Selection Process – Summary

- Worn Cutter WT - Application Recommendations
- WT – Worn Cutter - Potential Causes
- Washed Out Bit – WO – Application Recommendations
- WO – Washed Out Bit – Potential Causes
- Ring Out – RO – Application Recommendations
- RO – Ring Out – Potential Causes
- Plugged Nozzle/ - PN Waterway – Application Recommendations
- PN – Plugged Nozzle / Waterway – Potential Causes
- Lost Cutter – LT – Application Recommendations
- LT – Lost Cutter – Potential Causes
- Lost Nozzle – LN – Application Recommendations
- LN – Lost Nozzle – Potential Causes
- Lost Matrix – LM – Application Recommendations
- LM – Lost Matrix – Potential Causes
- Junk Damage – JD – Application Recommendations
- JD – Junk Damage – Potential Causes
- Heat Checking – HC – Application Recommendations
- HC – Heat Checking – Potential Causes
- Erosion – ER – Application Recommendations
- ER – Erosion – Potential Causes
- Delaminated Cutters – DL – Application Recommendations
- DL – Delaminated Cutters – Potential Causes
- Chipped Cutter – CT – Application Recommendations
- CT – Chipped Cutter – Potential Causes
- Cored – CR – Application Recommendations
- CR – Cored – Potential Causes
- Balled Up – BU – Application Recommendations
- BU – Balled Up – Potential Causes
- Broken Cutters – BT – Application Recommendations
- BT – Broken Cutters – Potential Causes
- Bond Failure – BF – Application Recommendations
- BF – Bond Failure – Potential Causes
- Cutter Types & Nomenclature
- Bi – Center

- Impregnated Bits (XTN, XTS)
- Worn Teeth – WT – Application Recommendations
- WT Worn Teeth – Potential Causes
- Washed Out Bit – WO – Application Recommendations
- WO – Washed Out Bit – Potential Causes
- Tracking – TR – Application Recommendations
- TR – Tracking – Potential Causes
- Self Sharpening Wear – SS
- Shirttail Damage – SD – Application Recommendations
- SD – Shirttail Damage – Potential Causes
- Rounded Gauge – RG – Application Recommendations
- RG – Rounded Gauge – Potential Causes
- Plugged Nozzle – PN – Application Recommendations
- PN – Plugged Nozzle – Potential Causes
- Pinched Bit – PB – Application Recommendations
- PB – Pinched Bit – Potential Causes
- Off Center Wear – OC – Application Recommendations
- OC – Off Center Wear – Potential Causes
- Lost Teeth – LT – Application Recommendations
- LT – Lost Teeth – Potential Causes
- Lost Nozzle – LN – Application Recommendations
- LN – Lost Nozzle – Potential Causes
- Lost Cone – LC – Application Recommendations
- LC – Lost Cone – Potential Causes
- Junk Damage – JD – Application Recommendations
- JD – Junk Damage – Potential Causes
- Heat Checking – HC – Application Recommendations
- HC – Heat Checking – Potential Causes
- Flat Crested Wear – FC – Application Recommendations
- FC – Flat Crested Wear – Potential Causes
- Erosion – ER – Application Recommendations
- ER – Erosion – Potential Causes
- Chipped Teeth – CT – Application Recommendations
- CT – Chipped Teeth – Potential Causes

- Cored – CR – Application Recommendations
- CR – Cored – Potential Causes
- Cone Interference – CI – Application Recommendations
- CI – Cone Interference – Potential Causes
- Cone Dragged – DC – Application Recommendations
- CD – Cone Dragged – Potential Causes
- Cracked Cone – CC – Application Recommendations
- CC – Cracked Cone – Potential Causes
- Balled Up – BU – Application Recommendations
- BU – Balled Up – Potential Causes
- Broken Teeth – BT – Application Recommendations
- BT – Broken Teeth – Potential Causes
- Broken Cone – BC – Application Recommendations
- BC – Broken Cone – Potential Causes
- Conventional Cutting Structure
- TrucutTM Cutting Structure
- IADC Code Roller Cone Comparison Chart
- Roller Cone Availability Chart – Insert Bits
- Roller Cone Availability Chart – Tooth Bits
- Stick – Slip – Observation, Solution & Remarks
- Whirl – Observation, Solution & Remarks
- Hydraulics
- Drilling Fluids & Hydraulics
- Hydrostatic Pressure of Water
- Hydrostatic Pressure of Drilling Mud
- PASCAL's Law
- Fluid Flow Principles
- Measuring Flow
- Deformation of a Fluid by Simple Shear
- Fluid Models
- Newtonian
- Non-Newtonian
- Rotating Sleeve Viscometer or VG Meter
- Stages of Flow

- Bit Pressure Drop (psi)
- Pump Pressure
- Sum of System Pressure Losses
- Calculating Hydraulics
- Optimizing Hydraulics
- Bit Hydraulic Horsepower (BHHP)
- Jet Impact Force
- HHP Theory
- Jet Impact Theory
- Max Impact versus Max Bit HHP
- Bit HHP versus Flow Rate
- Impact Force versus Flow Rate
- Straight Nozzle Bore – Increases Flow Efficiency
- Lab Scale Testing Facility
- Tests
- Vortex Nozzle Analysis
- Objectives
- Technical Approaches
- CFD Analysis of Vortex Nozzle
- Flow Pattern Around Bit and Hole
- Example Solution from CFD Simulation
- Modular Nozzle Design
- Operating Procedures/Parameters
- Session Objectives
- Session Outline
- Pre-Run Procedures
- Running into the Hole
- Drilling Out of Shoes
- Optimize WOB and RPM
- Drill-Off Tests
- Identifying Problems
- Corrective Actions
- Summary of Bit Operations
- Directional Drilling – Bi-Center BHA / bits and Vibration in Vertical Wells

- Bi-Center Bits
- What is the Purpose of a Bi-Center Bit?
- Bi-Center Bit – Casing Shoe Drill Out
- Bi-Center BHA's
- BHA Stabilization
- Bi-Center – Stabilizers
- Competent Formations
- Bi-Center Bit Problems
- Log Quality Example
- Vibration
- BHA Whirl
- BHA Modeling for Critical RPM's
- Effective Length
- Mud Motors
- Off Bottom
- Planning Bi-Center BHA Runs
- Directional Drilling – Bi-Center Bits (BHA Examples)
- DK 495 Dukhan Qatar
- DK 507 Dukhan Qatar
- HRDH – 1702 Saudi