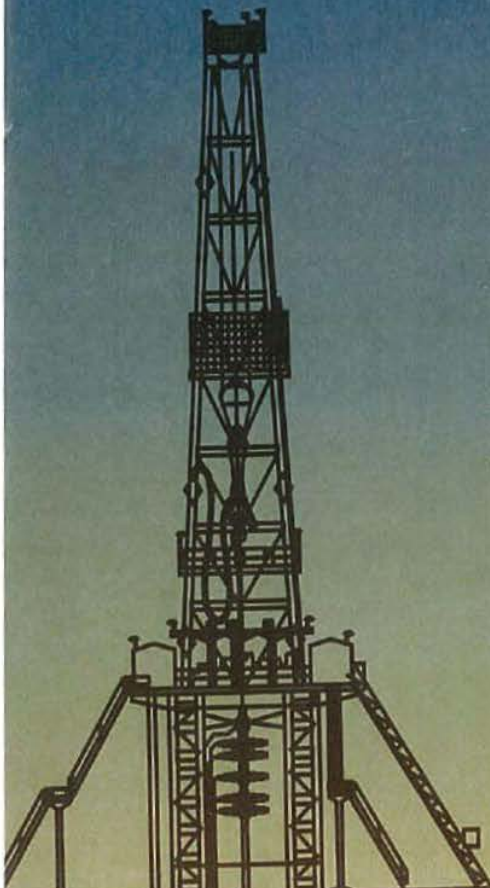


ROTARY DRILLING

The Rotary Rig and Its Components

Fourth Edition

UNIT I • LESSON 1



ROTARY DRILLING SERIES

Unit I: The Rig and Its Maintenance

- Lesson 1: The Rotary Rig and Its Components
- Lesson 2: The Bit
- Lesson 3: Drill Pipe and Drill Collars
- Lesson 4: Rotary, Kelly, and Swivel
- Lesson 5: The Blocks and Drilling Line
- Lesson 6: The Drawworks and the Compound
- Lesson 7: Power and Power Transmission
- Lesson 8: Circulating Systems
- Lesson 9: The Auxiliaries
- Lesson 10: Safety on the Rig
- Lesson 11: Diesel Engines and Electric Power
- Lesson 12: Mud Pumps and Conditioning Equipment

Unit II: Normal Drilling Operations

- Lesson 1: Making Hole
- Lesson 2: Drilling Mud
- Lesson 3: Drilling a Straight Hole
- Lesson 4: Casing and Cementing
- Lesson 5: Testing and Completing

Unit III: Nonroutine Rig Operations

- Lesson 1: Controlled Directional Drilling
- Lesson 2: Open-Hole Fishing
- Lesson 3: Blowout Prevention
- Lesson 4: Subsea Blowout Preventers and Marine Riser Systems

Unit IV: Man Management and Rig Management

Unit V: Offshore Technology

- Lesson 1: Wind, Waves, and Weather
- Lesson 2: Spread Mooring Systems
- Lesson 3: Buoyancy, Stability, and Trim
- Lesson 4: Jacking Systems and Rig Moving Procedures
- Lesson 5: Diving and Equipment
- Lesson 6: Vessel Maintenance and Inspection
- Lesson 7: Helicopter Safety and Survival Procedures
- Lesson 8: Orientation for Offshore Crane Operation
- Lesson 9: Life Offshore

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The Rotary Rig

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Unit I, Lesson 1
Fourth Edition



By K. R. Bork

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FOREWORD



For many years, the Rotary Drilling Series has oriented new personnel and further assisted experienced hands in the rotary drilling industry. As the industry changes, so must the manuals in this series reflect those changes.

The revisions to both text and illustrations are extensive. In addition, the layout has been “modernized” to make the information easy to get; the study questions have been rewritten; and each major section has been summarized to provide a handy comprehension check for the student.

PETEX wishes to thank industry reviewers—and our readers—for invaluable assistance in the revision of the Rotary Drilling Series. On the PETEX staff, Deborah Caples designed the layout; Doris Dickey proofread innumerable versions; Sheryl Horton saw production through from idea to book; Ron Baker served as content editor for the entire series.

Although every effort was made to ensure accuracy, this manual is intended to be only a training aid; thus, nothing in it should be construed as approval or disapproval of any specific product or practice.

Kathy Bork

Acknowledgments



Special thanks to Ken Fischer, director, Committee Operations, International Association of Drilling Contractors, who reviewed this manual and secured other reviewers, and to Kathy Glass, who kept track of the review process. John Altermann, Reading & Bates Drilling Company; Jim Arnold, Salem Investment; Joey Hopewell, Delta Drilling Company; and Paul Hudson, PETEX-Odessa provided invaluable suggestions on the content and language. Diamond Offshore was extremely generous in allowing us access to an offshore rig—the Ocean America—and two land rigs—rigs 840 and 859. John L. Kennedy graciously gave us permission to adapt drawings from *Fundamentals of Drilling: Technology and Economics* (Tulsa, Okla.: PennWell Publishing, 1983). Jonell Clardy clarified the sometimes difficult text with wonderful new drawings and Terry Gregston braved the weather in the Gulf of Mexico and South Texas to take new photographs.

Units of Measurement



Throughout the world, two systems of measurement dominate: the English system and the metric system. Today, the United States is almost the only country that employs the English system.

The English system uses the pound as the unit of weight, the foot as the unit of length, and the gallon as the unit of capacity. In the English system, for example, 1 foot equals 12 inches, 1 yard equals 36 inches, and 1 mile equals 5,280 feet or 1,760 yards.

The metric system uses the gram as the unit of weight, the metre as the unit of length, and the litre as the unit of capacity. In the metric system, for example, 1 metre equals 10 decimetres, 100 centimetres, or 1,000 millimetres. A kilometre equals 1,000 metres. The metric system, unlike the English system, uses a base of 10; thus, it is easy to convert from one unit to another. To convert from one unit to another in the English system, you must memorize or look up the values.

In the late 1970s, the Eleventh General Conference on Weights and Measures described and adopted the *Système International (SI) d'Unités*. Conference participants based the SI system on the metric system and designed it as an international standard of measurement.

The *Rotary Drilling Series* gives both English and SI units. And because the SI system employs the British spelling of many of the terms, the book follows those spelling rules as well. The unit of length, for example, is *metre*, not *meter*. (Note, however, that the unit of weight is *gram*, not *gramme*.)

To aid US readers in making and understanding the conversion to the SI system, we include the following table.

Introduction



Since oil and gas are normally found far below the surface, special means of reaching them and bringing them to the surface must be used. Drilling through perhaps thousands of feet of earth, removing the dirt and rock from the hole as it is drilled, keeping the hole from caving in while it is being drilled, finding a particular layer of earth where oil or gas may be trapped, and providing a means of bringing it to the surface require considerable expertise, labor, and equipment. The primary equipment in this process is the rotary drilling rig and its components.

A rotary drilling rig, whether on land or offshore, may be thought of as a factory designed to produce only one product—an oilwell, or “hole,” as it’s called in the business. This hole is a carefully planned path from the surface to a formation that may contain hydrocarbons. A rig differs from other manufacturing facilities, however, in that, once the hole is completed and the oil or gas is flowing to the surface, the rig is no longer needed to continue production. Once a well is drilled, the rig and its components can be disassembled, moved, and reassembled at a new location, to begin drilling again.

Portability does not, however, greatly limit a rig’s capability to drill, or make hole. It simply makes the rig more cost-effective in that it can be used over and over. Because a rig must be portable, each component can be divided into compact modules and moved overland by trucks, cargo planes, or helicopters, or it can be towed to a new site offshore.