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Petroleum and natural gas industries — Flexible pipe systems for subsea and marine riser applications

*Industries du pétrole et du gaz naturel — Systèmes de canalisations
flexibles pour applications sous-marines et en milieu marin*



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Foreword

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International Standard ISO 10420 was prepared by the American Petroleum Institute (API) (as RP 17B, 1st edition) and was adopted, under a special "fast-track procedure", by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum and natural gas industries*, in parallel with its approval by the ISO member bodies.

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Introduction

International Standard ISO 10420:1994 reproduces the content of API RP 17B, 1st edition, 1988. ISO, in endorsing this API document, recognizes that in certain respects the latter does not comply with all current ISO rules on the presentation and content of an International Standard. Therefore, the relevant technical body, within ISO/TC 67, will review ISO 10420:1994 and reissue it, when practicable, in a form complying with these rules.

This standard is not intended to obviate the need for sound engineering judgement as to when and where this standard should be utilized and users of this standard should be aware that additional or differing requirements may be needed to meet the needs for the particular service intended.

Standards referenced herein may be replaced by other international or national standards that can be shown to meet or exceed the requirements of the referenced standards.

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Petroleum and natural gas industries — Flexible pipe systems for subsea and marine riser applications

1 Scope

This International Standard provides guidelines for the design, analysis, testing, storage, handling and installation of flexible pipe systems used in a variety of offshore oil production applications.

2 Requirements

Requirements are specified in:

“API Recommended Practice 17B (RP 17B), 1st edition, June 1, 1988 — *Recommended Practice for Flexible Pipe*”

which is adopted as ISO 10420.

For the purposes of international standardization, however, modifications shall apply to specific clauses and paragraphs of publication API RP 17B. These modifications are outlined below.

Page 9

Information given in the POLICY is relevant to the API publication only.

Page 10

Subclause 1.2, Applicable standards

API standards referenced in subclause 1.2 and listed hereafter are available under the following ISO references:

API BUL 5C3 as ISO 10400

API RP 6G as ISO 10406

Page 41

Section 8, References

This section is informative. The documents listed therein constitute a bibliography.

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Recommended Practice for Flexible Pipe

API RECOMMENDED PRACTICE 17B (RP 17B)
FIRST EDITION, JUNE 1, 1988

American Petroleum Institute
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TABLE OF CONTENTS

	Page
FOREWORD	4
POLICY	5
SECTION 1 — GENERAL	
1.1 Scope	6
1.2 Applicable Standards	6
SECTION 2 — DEFINITIONS AND ABBREVIATIONS	
2.1 Definitions	7
2.2 Abbreviations	8
SECTION 3 — SYSTEM DESCRIPTION	
3.1 Scope	9
3.2 Applications	9
3.3 Construction Types	9
3.3.1 Non-bonded Construction	9
3.3.2 Bonded Construction	9
3.4 End Fittings	9
3.5 Bend Limiters	9
3.6 Bend Stiffeners	9
3.7 Buoyancy Devices	10
SECTION 4 — OPERATIONAL REQUIREMENTS AND DESIGN CONSIDERATIONS	
4.1 Scope	13
4.2 General	13
4.3 Mechanical Considerations	14
4.3.1 Dimensional	14
4.3.2 Internal Pressure	14
4.3.3 Collapse	14
4.3.4 Tensile Load	14
4.3.5 Flexibility	15
4.3.6 Minimum Bend Radius	15
4.3.7 Weight and Buoyancy	15
4.3.8 Torsion	15
4.3.9 Rapid Decompression	15
4.4 Transported Fluid Considerations	15
4.4.1 Temperature Limits	15
4.4.2 Fluid Properties	15
4.4.3 Fluid Velocity	15
4.4.4 Pipe Roughness	16
4.5 External Environment Considerations	16
4.5.1 Temperature Limits	16
4.5.2 Fire Resistance	16
4.5.3 External Protection	16
4.5.4 Anti-fouling	16
4.5.5 Environmental Conditions	16

TABLE OF CONTENTS (continued)

Page

4.6	Other Considerations	16
4.6.1	Static or Dynamic Application	16
4.6.2	Thermal Insulation	16
4.6.3	On-Bottom Behavior	16
4.6.4	Trenching	16
4.6.5	Pigging/TFL Requirements	16
4.6.6	Service Life	16
4.6.7	End Fitting	17
4.6.8	Bend Limiter/Stiffener	17
4.6.9	Permeability	17
4.6.10	Electrical Continuity	17
4.6.11	Structural Damping	17
4.6.12	Appurtenances	17
SECTION 5 — ANALYSIS CONSIDERATIONS		
5.1	Scope	18
5.2	Analysis Objectives	18
5.3	Analysis Parameters	18
5.3.1	Pipe Characteristics	18
5.3.2	Operational Data	18
5.4	Analysis Procedures	19
5.4.1	General	19
5.4.2	System Static Analysis	19
5.4.3	System Dynamic Analysis	19
5.4.4	Local Stress Analysis	20
5.4.5	Component Analysis	20
5.4.6	Flow-Induced Motion Analysis	20
5.4.7	Service Life Analysis	20
SECTION 6 — QUALITY ASSURANCE AND QUALITY CONTROL		
6.1	General	21
6.2	Quality Assurance of Design	21
6.3	Quality Assurance of Procurement	21
6.4	Quality Assurance of Processing	21
6.4.1	Welding	21
6.4.2	Repair of Defects	21
6.4.3	Marking of Pipe	21
6.5	User Inspection	21
6.5.1	Scope	21
6.5.2	General	21
6.5.3	Documentation	22
6.5.4	Acceptance Tests	22
6.5.5	Test Certificates	22
6.6	Testing	22
6.6.1	General	22
6.6.2	Prototype Tests	22
6.6.3	Acceptance Tests	23
6.6.4	Special Tests	29

TABLE OF CONTENTS (Continued)		Page
SECTION 7 — STORAGE, HANDLING, TRANSPORTATION AND INSTALLATION		
7.1	Scope	34
7.2	Storage	34
7.2.1	Reels	34
7.2.2	Baskets	34
7.2.3	Crates/Pallets	34
7.2.4	Storage Conditions	34
7.3	Handling and Transportation	34
7.4	Installation	34
7.4.1	Installation Methods and Equipment	34
7.4.2	Installation Loads	35
7.4.3	Intermediate Connections	36
7.4.4	Retrieval for Reuse	36
SECTION 8 — REFERENCES		37

RECOMMENDED PRACTICE FOR FLEXIBLE PIPE
FOREWORD

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SECTION 1 GENERAL

1.1 Scope. This Recommended Practice provides guidelines for the design, analysis, quality assurance, storage, handling, transportation, and installation of flexible pipe systems for subsea and marine riser applications. In general, flexible pipe is a custom-built product which can be manufactured in a variety of methods. It is not the intent of this document to discourage novel or new developments in the flexible pipe market. On the contrary, it is recognized that a variety of designs and methods of analysis are possible. For this reason some topics are presented in general terms, in a commentary form, to provide guidance to the user while still leaving the door open to alternative approaches.

This Recommended Practice applies to flexible pipe with a design pressure greater than 225 psi and used in a variety of offshore oil production applications. Typical applications include risers, pipelines, and pipeline/flowline tie-ins.

While the treatment of flexible pipe in this RP is general and deals with a variety of applications, low pressure (design pressure not greater than 225 psi) hoses, flexible choke and kill lines, and hydraulic control lines are beyond the scope of this RP. Flexible pipe which will carry chemicals other than those expected in an oil production application are also outside the scope of this RP.

Several factors justify the need for this Recommended Practice. Flexible pipe systems are already used in a variety of applications offshore, and as the industry moves to frontier areas, such as deepwater, the number of potential applications increases. While the number of applications is growing, so also are the number of manufacturers and the types of construction. In addition, the design and analysis of flexible pipe are made difficult by its multilayered composite construction involving different materials.

This document is not intended to offer a comprehensive treatment of flexible pipe. It will be revised as new information becomes available.

1.2 Applicable Standards. The following standards are referenced in part or in whole in this Recommended Practice. It is recognized that additional standards have been developed by other bodies. Therefore this listing is representative and should not be consid-

ered as either all inclusive or exclusive of other standards relating to topics covered in this RP.

American Petroleum Institute

SPEC Q1	Quality Programs
RP 2Q	Design and Operation of Marine Drilling Riser Systems
BUL 5C3	Formulas and Calculations for Casing, Tubing, Drill Pipe, and Line Pipe Properties
SPEC 6FA	Specification for Fire Test for Valves Through Flowline (TFL) Pump Down Systems
RP 17A	Design and Operation of Subsea Production Systems
STD 1104	Welding Pipelines and Related Facilities
RP 1110	Pressure Testing of Liquid Petroleum Pipelines
RP 1111	Design, Construction, Operation and Maintenance of Offshore Hydrocarbon Pipelines

American Society for Testing and Materials

ASTM-D-413	Adhesion to Flexible Substrate
ASTM-D-2143	Cyclic Pressure Strength of Reinforced, Thermosetting Plastic Pipe
ASTM-D-2924	External Pressure Resistance of Reinforced Thermosetting Resin Pipe

Lloyd's Register of Shipping

ICE/FIRE, OSG 1000/499	Flexible Hoses on Offshore Installations (Fire Test)
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National Association of Corrosion Engineers

MR-01-75	Sulfide Stress Cracking Resistant Metallic Material for Oil Field Equipment
RP 01-75	Control of Internal Corrosion in Steel Pipelines and Piping Systems

Oil Companies International Marine Forum

Hose Standards: Specification for Rubber, Reinforced, Smooth Bore, Oil Suction and Discharge Hoses for Offshore Moorings (Including Purchaser's Inspection Guide), 3rd Edition, 1 September 1978.

SECTION 2

DEFINITIONS AND ABBREVIATIONS

2.1 Definitions

BEND LIMITER: A mechanical device that functions as a mechanical stop and limits the local radius of curvature of the flexible pipe to a minimum value. Can also be called bend restricter.

BEND RESTRICTER: See bend limiter.

BEND STIFFENER: Flexible pipe construction aimed at increasing the bending stiffness in a localized region to reduce maximum stresses when large bending moments are expected. Can also be called strain relief unit.

BENDING STIFFNESS: Bending stiffness in a flexible pipe is analogous to the structural stiffness of a rigid beam or pipe (modulus of elasticity times the second area moment of inertia), except that it can vary to a larger extent with temperature and pressure. It is often quantified as the product of an applied bending moment times the resultant bend radius of the pipe.

CARCASS: An interlocked metallic construction that can be used as one of the flexible pipe component layers.

CHINESE LANTERN CONFIGURATION: A quasi-vertical shape for a riser supported by distributed or continuous buoyancy. See Figure 2.1.

CONNECTOR: A device used to provide a leak-free structural connection at the end of a length of flexible pipe. Connectors include bolted flanges, clamped hubs, and proprietary connectors. They may be designed for diver-assisted makeup or for diverless operation using either mechanical or hydraulic apparatus.

END FITTING: The flexible pipe end construction, including the termination of the different flexible pipe layers and the connector. See termination or connector.

END-CUT: Open section of flexible pipe which has been cut for future installation but did not receive an end fitting.

FLEXIBLE PIPE: A pipe that can perform functions similar to rigid pipe, and which can also withstand large curvature without adverse effects.

FREE HANGING CONFIGURATION: The shape, typically a catenary, that a flexible pipe takes when suspended between two points and acted upon only by its own weight. See Figure 2.1.

H₂S SERVICE: H₂S service is defined as fluid service conditions containing above 0.05 psi partial pressure of hydrogen sulfide calculated at working pressure.

INTEGRAL FLEXIBLE PIPE CONSTRUCTION: An assembly of individual flexible pipelines, electrical cable, optical fibers, etc., constrained by a common continuous outer jacket. Can also be called multibore construction.

LAY ANGLE: In flexible pipe fabrication this is the angle between the axis of the armor wire and a line parallel to the flexible pipe axis.

LAZY S CONFIGURATION: A double catenary shape taken by a flexible pipe riser when the riser runs from the surface to the seafloor over a midwater pipe tray supported by a subsurface buoy. The buoy may be kept in position by a chain or cable attached to a deadweight anchor positioned on the seafloor. See Figure 2.1.

LAZY WAVE CONFIGURATION: Similar to the Lazy S configuration with the pipe tray and the subsurface buoy replaced by an appropriate distribution of smaller buoyancy modules along a section of the riser. Also, the lazy wave configuration does not require a deadweight anchor. See Figure 2.1.

MINIMUM BEND RADIUS (MBR): The minimum radius of curvature, measured from the pipe centerline, that the flexible pipe can sustain without damage. Damage caused by excessive bending can take several forms, such as crushing of the interlocked steel carcass, local buckling, permanent deformation, or loss of bonding between adjacent layers. Different values may be applicable for the minimum bend radius for different conditions, such as storage, installation and operation. Also, the minimum bend radius may be different for static and dynamic applications.

MULTIBORE FLEXIBLE PIPE CONSTRUCTION: See integral flexible pipe construction.

NON-INTEGRAL FLEXIBLE PIPE CONSTRUCTION: An assembly of individual flexible lines installed in parallel and constrained together at one or more intermediate points along their length. These constraints may be a pipe tray, a common flotation device, or spacer bars.

PERMEABILITY: The characteristic of a material to allow a fluid (liquid or gas) to pass through it. In flexible pipe, permeability may allow gases to pass through the primary fluid-containing layer and build up in the interplay region.

PIPE TRAY: The support of the flexible pipe when a riser is set in a Lazy S or Steep S configuration. It transmits the buoyancy force to the flexible pipe while keeping it at an acceptable curvature.

PRESSURE: See Section 4.3.2 for definitions of design, operating, test, and burst pressures.

QUALITY: Conformance to specified requirements.

QUALITY ASSURANCE: Those planned, systematic, and preventive actions which are required to ensure that materials, products, or services will meet specified requirements.