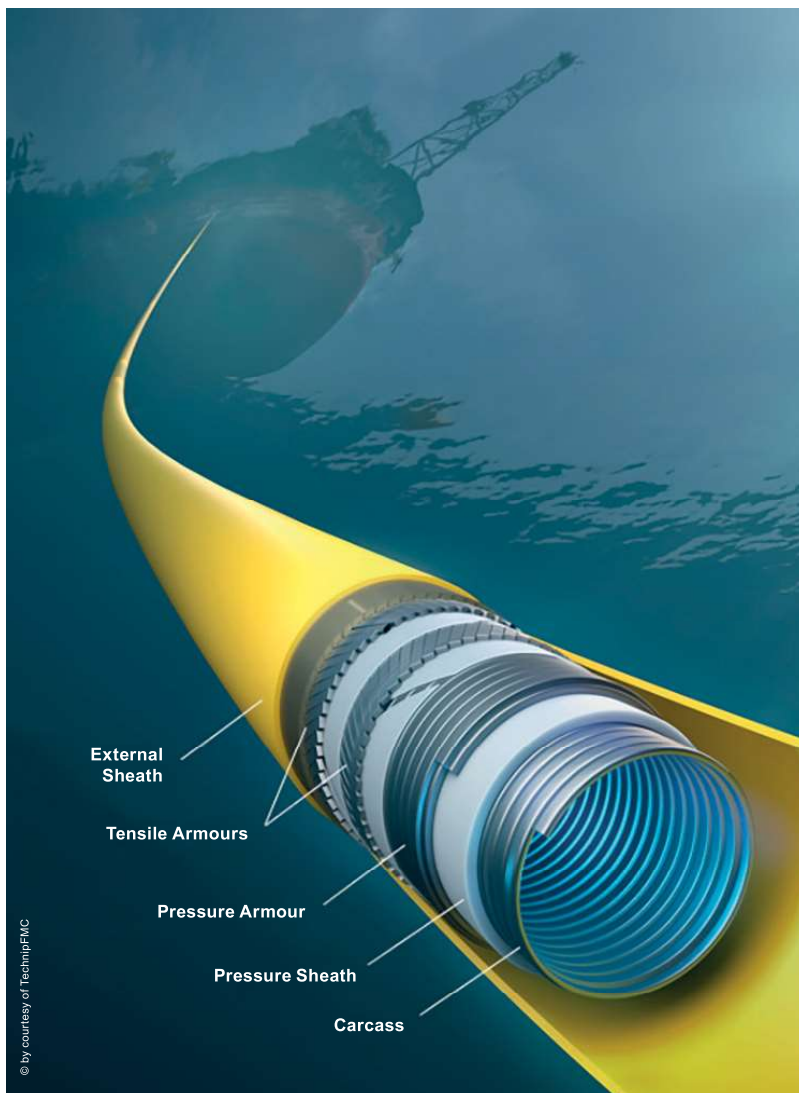


GUIDELINE FOR QUALIFICATION

OF PRESSURE AND OUTER SHEATH MATERIALS IN UNBONDED FLEXIBLE PIPE



Unbonded flexible pipes manufacturers spend significant efforts in R&D, either for technical or economic purposes. New design solutions and improvements may in particular concern the internal pressure sheath. This layer aims at providing leak proofness to the transported fluid (gas, liquid or combination of both) in high temperatures and pressures, while being submitted to severe contact, deformations, creeping and fatigue loads. Other polymeric sheaths such as outer sheath, protective sheath or intermediate sheath fulfill also critical functions in the flexible pipes e.g. to prevent water ingress in the annulus.



Small-scale tests and full-scale tests are performed to determine material properties and qualify the materials for pressure sheath and outer sheath versus their actual environment while considering relevant interactions with the other layers (pipe body and end-fitting area).

Small scale testings, as specified in API 17J, are not fully representative of the actual surroundings / conditions seen by the pressure sheath and outer sheath in the flexible pipes. API 17B recommends several full-scale test types however without establishing a clear link with respect to those needed for pressure sheath and outer sheath qualification.

Considering these weaknesses in API 17J/B, Operators have raised concerns with respect to (1) the suitability of new pressure sheath material qualification or (2) the suitability of extended envelopes of utilization for known materials.

These concerns apply to the flexible pipe body as well as to the end-fitting sealing design. This led to the release of IOGP 645 in 2022 which includes five full-scale tests protocols (fatigue test, modified temperature test, temperature/pressure cycling, pressurization/depressurization, swelling test) focusing only on internal pressure sheath qualification. IOGP 645 was rejected by the 3 flexible pipe manufacturers during the API 17J 5th edition discussions in 2022-2023.

There is therefore a need to enhance the qualification process by developing a methodology aiming at establishing the list of qualification tests for pressure sheath and outer sheath materials in unbonded flexible pipes and to define test protocols. The need is high in the industry considering new polymeric materials, new fluids to be transported and extended design/operating conditions.



BUREAU
VERITAS

To develop a guideline defining the requirements to qualify a polymeric sheath, aligned with expectation from the industry for all unbonded flexible pipe applications, BV propose a Joint Industry Project: SheathFlex.

OBJECTIVE

The proposed JIP will:

- Gather all the manufacturers and operators to align on:
 - the methodology to establish the list of qualification tests to be performed
 - the minimum qualification tests needed per type of polymer/material family and applications
 - the complementary qualification tests
 - the test procedure principles together with their requirements for each qualification tests (required and complementary tests)
- Issue a guideline defining the requirements to qualify internal pressure sheath and external sheath materials for unbonded flexible pipe considering pipe body and end-fitting area.

SCOPE OF WORK

The priority will be made on the pressure sheath materials and then followed by the other sheaths (outer sheath, protective sheath and other intermediate sheath) materials.

WORK PACKAGE (WP) I: GENERAL METHODOLOGY TO QUALIFY FLEXIBLE PRESSURE SHEATH MATERIALS AND OUTER SHEATH

The different pressure sheath and outer sheath materials and their considered applications will be collected from the JIP participants.

Workshops with all JIP participants will be organized to review the materials to be covered during this JIP, to perform a functional analysis and a Qualification-FMECA describing all failure modes considering interactions with the other layers in pipe body and end-fitting aspects. 2-3 workshops are anticipated.

The JIP will then define a systematic methodology to qualify pressure sheath and outer sheath materials and extended envelopes of utilization for known materials.

The deliverable will be a report compiling all minimum tests and optional tests for each family of materials considering the application and the specificities of unbonded flexible pipe.

WP II: TEST REQUIREMENTS AND PROCEDURES

The objective of this Work Package is to align all JIP participants on test procedures principles for all tests defined in WP I. It is expected that BV gather all manufacturers and operators testing methods. A gap analysis will be performed between the proposed methods, the API 17J/B and IOGP 645.

In addition, BV propose to lead workshops to identify the specific needs for each family of materials used and derive the minimum requirements and criteria to fulfill for each test. 2 workshops are anticipated. The deliverable will be a report describing all the test procedure principles with some requirements and criteria to be fulfilled.

WP III: GUIDELINE ISSUANCE

Based on the findings of WP I and II, a document defining recommendations and methodology for reliable unbonded flexible pipes pressure sheath and outer sheath qualification will be issued by BV.

BENEFITS

- Transparency and guidelines for all stakeholders, with consensus among suppliers and operators
- Applicable to any pressure sheath and outer sheath material and different flexible pipe applications
- First global qualification scheme for unbonded flexible pipes pressure sheath and outer sheath

DELIVERABLES

BV will issue reports for all workshops discussions and will issue a guideline, to be written in close collaboration with all participants.

All design data will be anonymous to ensure the confidentiality of each material used.

SCHEDULE

The JIP will start during the fourth quarter of 2024, for a duration of one year and a half.

BUDGET AND PARTICIPATION FEES

- Cost of the JIP has been estimated at €200,000.
- Participation fees will depend on number of participants, manufacturers and operators and will be equally shared between participants.

BUREAU VERITAS

TOOLS AND EXPERTISE

Experience:

- Flexible pipe projects reviewed by BV : Petrobras LAPA SW, MERO3, Pre-salt qualification, Iracema Sul, Reliance, Totalenergies CLOV jumpers, KAOMBO, EGINA, BP QUAD 204...
- API 17J Type Approval Certificates for TechnipFMC and NOV Flexibles.
- Involvement in projects for Pressure Sheath material qualification.

PUBLICATIONS:

- **BV NI 364 Rev.1 2022**
– Verification scheme of Unbonded flexible pipes
- **OTC 2022-31811 –**
Assessment of new materials in unbonded flexible pipes

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