Certificate of Type Approval

This is to certify that the design methodology and the manufacturing processes for the product identified below was found to be in compliance with the stated Regulations and Standards

Product:	**Distributed Buoyancy Module and Internal Clamp**
Manufactured by:	Matrix Composites & Engineering 150 Quill Way Henderson WA Australia 6166
Specified regulations and standards:	API Specification 17L1: 2nd Edition: June 2021 (Specification for Ancillary Equipment for Flexible Pipes and Subsea Umbilicals)

We further certify that the manufacturer's arrangements for consistently manufacturing the product in accordance with the approved type have been assessed and found to be satisfactory.

This Type Approval Certificate is valid until: 15/11/2027

Issued by: Bureau Veritas UK Limited Craigshaw Business Park Craigshaw Road AB12 3AR Aberdeen	Author: Karolina Tanska Position: Design Verification Engineer	Approver: Charles Stewart Position: Senior Mechanical Engineer
	Signature & Stamp:	Signature & Stamp:
	Date: 15th November 2022	Date: 15th November 2022

Certificate Revision History

Revision	Reason for Revision
0	Initial Issue

Schedule of Approval

1 Product Description:

Matrix Composites & Engineering have developed a Distributed Buoyancy Module (DBM) and associated clamp for use in flexible riser/umbilical applications. A number of buoyancy modules correctly spaced along the flexible riser/umbilical are used to achieve the required wave-shape riser/umbilical configuration. These Distributed Buoyancy Modules and clamps are developed on a project specific basis, Bureau Veritas' scope of work was to provide Type Approval Certification to verify the design methodology, manufacturing process and testing of these elements with regards to design code API Specification 17L1: 2nd Edition along with other applicable referenced codes specified in this certificate.

2 Application/Limitations:

Typical application parameters to be considered project specific:

- Max. design life
- Max. operating depth
- Overall calculated module assembly weight in air
- Buoyancy based on SW density
- Overall initial module net buoyancy at atmospheric pressure
- Short term buoyancy at max. operating depth
- Long-term buoyancy
- Min. seawater temperature
- Max. seawater temperature
- Buoyancy retaining fastener size / torque

Bureau Veritas has assessed the Buoyancy Modules which are documented by the complementary Independent Appraisal Report for which this Certificate of Type shall always be read in conjunction with:

22ABD10931 Rev. 0 Complimentary Independent Appraisal Report

3 Design Calculations, Design Methodology, Drawings, Documentation and Specifications:

Document Title	Document No.	Rev.
Top Level Assembly - 1500 x 1500 DBM	655324	0
Buoyancy Element - Detailed View	655325	0
Strap, DBM, 50 kN Break Load, 60mm Wide, Pin-Pin Length 4298 mm	655324-001	0
M12 Single-Bolt Tensioner Assembly For 60mm x 20mm Cut Multi-Strap	810734	0
Compliant DBM Clamp Assembly - Flexible Riser ST 254.12371	711660	0
M30 Tensioner Assembly for DBM Clamp	810730	1
Clamp Element - 300-375 mm Pipe OD - M30 Fastener	711658	1
Compliant DBM Clamp Elastomer Liner - Flexible Riser ST 254.12371	711660-001	0
Compliant DBM Clamp Strap - Flexible Riser ST 254.12371	711660-002	0
Compliant Clamp Analysis - Mathcad Sheet	E1077	0
Hydrostatic Buoyancy Loss Analysis (API-17L)	E378	8
Hydrostatic Crush Test Analysis (Composite Foam)	E377	2

Document Title	Document No.	Rev.
Design Premise - API 17L	E426	2
DBM Compliance assessment for API 17L	E453	1
Design Report - DBM System	E454	4
Design Process - DBM System	E461	1
DBM Handling, Storage and Installation Procedure	E333	3
Qualification Plan - Composite Syntactic Foam	E335	6
Fatigue Testing of Distributed Buoyancy Materials	E345	2
Qualification Plan - Thermoplastic Clamp Element Material	E355	3
Prototype Testing Plan - DBM Clamp	E359	2
Qualification Plan - Reinforced Skins	E406	2
Flexural Creep Testing Procedure	E107	4
Qualification Plan - Elastomeric Materials for Clamping Devices	E842	2
Qualification Plan - DBM Shell Material	E798	1
Buoyancy Verification and Hydrostatic Test Procedure (API-17L)	E1049	0
Qualification Testing Report - 4000m Production Foam	T441	3
Qualification Report - Aramid Straps	E338	1
Qualification Testing Report - Reinforced Skins	E418	5
Qualification Testing Report - Production Foam 999226	E439	4
Qualification Testing Report - Thermoplastic 511574	T453	3
Qualification Test Report - RM HDPE	T420	5
Qualification Test Report - EPDM-70	T434	4
MDS - ASTM B348 - Titanium Gr.5	E450	2
Inspection and Test Plan for DBM	E1079	0
Qualification Test Report - Campoxy MAT 615 Paint	T417	1
Compatibility Testing of DBM Materials	T542	0
FAT Report for DBM Elements	RD0196-RPT-102	1
FAT Report for API 17L, DBM Clamp	RD0196-RPT-103	0
Handling of Buoyancy Elements	E427	1
Hydrostatic Performance Report Buoyancy Loss Test	HTN 2171	02/11/22

Bureau Veritas' approval of the above documents are detailed in the complementary Independent Appraisal Report (22ABD10931 Rev. 0).

4 Material Specifications:

Matrix Composites & Engineering shall produce records of tests demonstrating that the material selected for a specific application meet the functional requirements specified for the ancillary equipment, for the service life for storage, transport, installation, and operation conditions.

Materials detailed below have been reviewed against the requirements of API Specification 17L1: 2nd Edition.

Clamp	Glass-Reinforced Thermoplastic Polymer 511574
Buoyancy Elements	Composite Syntactic Foam [Ref. Note 1 below] with either a Fibreglass Reinforced Polymer or a Roto-Moulded Grade of High-Density Polyethylene (HDPE) Buoyancy Skin System
Clamp and Buoyancy Element Restraining Straps	Aramid Fibre
Clamp Inner Liner	Ethylene Propylene Diene Monomer (EPDM-70), Synthetic Rubber
Metallic Components	ASTM B348 Titanium Grade 5

Note 1: The buoyancy module foam core material qualification testing is carried out on a case-by-case basis, depending on the project parameters.

Matrix Composites & Engineering shall produce the qualification test records to prove the compliance of material selected for Buoyancy Module and Clamp to the requirement specified in Sections 4.4, 8.5 and 11.4 of API Specification 17L1: 2nd Edition.

5 Fabrication/Testing Procedures:

API Specification 17L1: 2nd Edition provides detailed procedures for performing factory acceptance tests (FATs). Matrix Composites & Engineering provided testing records from recently completed qualification program for new vendors.

6 Type Test reports/Laboratory Reports/Certificates:

Historic test reports RD0196-RPT-102 Rev. 1 and RD0196-RPT-103 Rev. 0 have been reviewed against the requirements of API Recommended Practice 17L2: 2nd Edition: June 2021. The Full-Scale Hydrostatic Test on foam system shall be witnessed as part of surveillance process, refer to Appendix A.

7 Marking of Product:

Marking of product shall comply with minimum requirements of section 4.8.1 of API Specification 17L1: 2nd Edition.

8 Certificate Retention:

The Type Approval Certificate is valid only if the Surveillance plan in Appendix A of this Certificate is followed.

9 Documentation to accompany each product:

The following Project Specific documentation shall accompany each product:
a) Design Premise
b) Design Report
c) Manufacturing Quality Plan
d) Installation Procedures
e) As-built documentation – with supplied ancillary equipment
f) Detailed engineering drawings

10 Comments:

10.1 Matrix Composites & Engineering shall demonstrate all relevant documents including design reports and calculations on a case-by-case basis for each project specific product.

10.2 Matrix Composites & Engineering shall ensure adequate lifting analysis and associated risk assessments are carried out when handling the Distributed Buoyancy Module and Internal Clamp, which shall be approved by the purchaser.

10.3 This Type Approval certifies that the design methodology and the manufacturing processes for the Approved Type were found to be in compliance with the stated regulations and standards. When in-service this product shall be subject to Verification and Examination and comply with the applicable shelf state requirements.

End of certificate

Appendix A – Surveillance Plan

Part (A) - Implementation of Quality Management System

* Mandatory Elements all Visits	**SURVEILLANCE** All activities & Processes must be audited at least once over each **5** year period

ELEMENTS TO BE EXAMINED	**Initial**	**Surv. 1**	**Surv. 2**	**Surv. 3**	**Surv. 4**	**Re Cert**
	Aug. 2022	*Aug. 2023*	*Aug. 2024*	*Aug. 2025*	*Aug. 2026*	*Aug. 2027*
*QMS / Manual / Policy / Objectives (4.4, 5.2, 6.2)	✓	✓	✓	✓	✓	✓
*Management Review (9.3)	✓	✓	✓	✓	✓	✓
*Internal Audit (9.2)	✓	✓	✓	✓	✓	✓
*Improvement / Internal NCR Process (10)	✓	✓	✓	✓	✓	✓
*Customer Satisfaction /Requirements (9.1.2)	✓	✓	✓	✓	✓	✓
*Roles, Responsibilities Competency, & Training (5.3, 7.2)	✓	✓	✓	✓	✓	✓
Resource Management (7.1.1, 7.1.2, 7.1.3, 7.1.4)	✓					✓
Design & Development (8.3)	✓					✓
Control of Documents (7.5)	✓					✓
Control of Records (7.5)	✓					✓
Customer Property (8.5.3)	✓					✓
Identification & Traceability (8.5.2)	✓					✓
Control of Product & Service Provision (8.5.1) (Process Control)	✓					✓
Inspection and Testing (8.3.4) #	✓					✓
Control of Monitoring & Measuring Equipment (7.1.5) (Calibration)	✓					✓
Operational Planning & Control (8.1, 8.2)	✓					✓
Control of Non-Conforming Product (8.7)	✓					✓
Preservation of Product (8.5.4)	✓					✓
Control of externally provided processes, products and services (8.4)	✓					✓
Responsibilities, Authority & Communication (5.3, 7.4)	✓					✓
Assessor's initials	HL					

1. In the Initial Assessment column, confirm by the use of a (✓) that all specified clauses have been audited.
2. In the Surveillance Audit columns, indicate by the use of a (✓), all of the clauses that have been audited during that Surveillance Audit and get agreement by the Client on the day of the Audit
3. In both Initial Assessment and Surveillance Audit columns, when Non-Conformance, Opportunity for Improvement or Best Practice has been raised, identify by marking with abbreviated Serial Number accordingly.
4. # check Part (B) for Additional Elements

Part (B) - Additional elements (Witness Manufacturing Tests)

Design: Distributed Buoyancy Module and Internal Clamp

Reference: API Recommended Practice 17L2: 2nd Edition: June 2021

Activity	ITP Activities (YEAR)
Witness Manufacturing Tests - Year 1* – Design Distributed Buoyancy Module and Internal Clamp	Buoyancy, IBL, Axial Slip Test & Complete Fit-Up
Witness Manufacturing Tests - Year 2 – Design Distributed Buoyancy Module and Internal Clamp	Buoyancy, IBL, Axial Slip Test & Complete Fit-Up
Witness Manufacturing Tests - Year 3 – Design Distributed Buoyancy Module and Internal Clamp	Buoyancy, IBL, Axial Slip Test & Complete Fit-Up
Witness Manufacturing Tests - Year 4 – Design Distributed Buoyancy Module and Internal Clamp	Buoyancy, IBL, Axial Slip Test & Complete Fit-Up

* First batch testing shall be witnessed/reviewed by Bureau Veritas.

Surveyor **Y1:**	Surveyor **Y2:**	Surveyor **Y3:**	Surveyor **Y4:**
BV Report No.: Date:	BV Report No.: Date:	BV Report No.: Date:	BV Report No.: Date:

To maintain the validity of this Certificate of Type Approval, quality management surveillance and endorsements of the witness manufacturing tests to be performed annually by a Bureau Veritas Surveyor.

End of Appendix