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:	**Dynamic Bend Stiffener (BSR)**
Manufactured by:	**Balmoral Comtec Limited** Balmoral Park Loirston Aberdeen AB12 3GY Scotland
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: 29/05/2030

Issued by:	Author: Callum MacLennan Position: Senior Engineer	Approver: Rahul Gopal Position: Senior Engineer
Bureau Veritas UK Limited The Quadrant, Poynernook Road, Aberdeen AB11 5QX	Signature & Stamp: 	Signature & Stamp: 
	Date: 16th December 2025	Date: 16th December 2025

Certificate Revision History

Revision	Reason for Revision
0	Recertification of Type Approval Certificate 15ABD10765 Rev. I

Schedule of Approval

1 Product Description:

Dynamic Bend Stiffeners are used to prevent the over-bending of a flexible pipe or umbilical under load.

There are three sections in Dynamic Bend Stiffeners:-

- The central active section, which is normally conical but may be modified to optimise the stiffness profile along the length. The diameter and length of the cone controls the loaded shape and bend radius of the stiffener and flexible/umbilical.
- An additional cylindrical section with a mounting flange and internal steelwork which joins the polyurethane cone to the end fitting. For dynamic BSRs, the end fitting has a combination of an inner tube to securely attach the polyurethane and an outer cage to provide extra support and reduce the stress on the polyurethane to steel bond at the mating flange face.
- A short straight section at the tip of the small end of the cone. This is to reinforce the thin area of the stiffener to inhibit tearing of the polyurethane.

Dynamic Bend Stiffener is designed as per requirement of API Specification 17L1: 2nd Edition.

2 Application/Limitations:

Flexible pipes or umbilicals carry a high risk of over-bending. Dynamic Bend Stiffeners act as a sleeve to these pipes/umbilicals to restrict the movement. The definition of a Dynamic Bend Stiffener can be summarised as shown below:

"Dynamic Bend Stiffener is a mechanical device consisting of a tapered elastomeric sleeve fitted over a flexible pipe, umbilical or cable to provide extra support and prevent overbending."

Design Limitations are assessed using reference documents listed in Section 3 of this report. Typical parameters to accompany the design report for each product are shown below:

Typical Parameters	
Design Life	Flexible/umbilical Bend Stiffness
Sea Water Density	Bend Stiffener ID
Service Temperature Range	Active Length
Global Bending Moment	Maximum Tension Angle
Global Shear Force	Dynamic Bend Stiffener (Central Active Section Material)
Operation MBR (Minimum Bend Radius)	Mounting Flange and Internal Steelwork Material

The design of the dynamic bend stiffeners verified by Bureau Veritas under this certificate are subject to the following limitations:

Manufacturing Limits	**BC-PU-108**	**BC-PU-107**
Maximum Pumping Capacity (PU Material)	11,200 kg (800 kg/min for 14 mins)	
Design Limits	**Value**	
Maximum Design Temperature (WET Condition)	+ 60 °C	+ 70 °C
Maximum Design Temperature (DRY Condition)	+ 90 °C	+ 90 °C

Bureau Veritas has assessed the Bend Stiffeners which are documented by the complementary independent appraisal report for which this Certificate of Type shall always be read in conjunction with:

25ABD10825 Rev. 0 Independent Appraisal Report

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

Historic Table of Document References

Title	**Reference No.**	**Rev.**
Dynamic Bend Stiffener Design Basis	14397-DB-1	01
Dynamic Bend Stiffener Structural Calculation	14397-DC-1	02
Dynamic Bend Stiffener Steel Fatigue Calculation	14397-DC-02	01
Dynamic Bend Stiffener PU Fatigue Calculation	14397-DC-03	01
Dynamic Bend Stiffener Design Report	14397-DR-01	02
Dynamic Bend Stiffener FEA Report	14397-DR-02	01
Inspection and Test Plan	14397-PD-002-001	06
Production Test Report	14397-PD-011-001	01
Dynamic Bend Stiffener General Arrangement	14397-GA-01	03
Dynamic Bend Stiffener Steelwork Assembly	14397-SA-01	01
Flange and Tube Assembly	DBS-2-00033	02
Spindle and Ring Assembly	DBS-2-00034	01
Dynamic Bend Stiffener Design Basis	14397-DB-1	01
Dynamic Bend Stiffener Structural Calculation	14397-DC-1	02
Dynamic Bend Stiffener Steel Fatigue Calculation	14397-DC-02	01
Dynamic Bend Stiffener PU Fatigue Calculation	14397-DC-03	01
Dynamic Bend Stiffener Design Report	14397-DR-01	02
Production Test Procedure	14397-PD-010-001	01
BC-PU-107 API 17L1 Qualification	BGLR 75277	01
Certificate of Type Approval Dynamic Bend Stiffener (BSR)	15ABD10765	I

Addition of Documentation References

Title	Reference No.	Rev.
Dynamic Bend Stiffener Design Basis	DBS-DB-1	02
Dynamic Bend Stiffener Calculation	DBS-DC-1	03
Dynamic Bend Stiffener Fatigue Calculation	DBS-DC-2	02
Dynamic Bend Stiffener Design Report	DBS-DR-1	03
Dynamic Bend Stiffener General Arrangement (Bolted Tube)	DBS-GA-1	02
Dynamic Bend Stiffener General Arrangement (Ring and Spindle)	DBS-GA-2	02
Dynamic Bend Stiffener Steelwork Assembly (Bolted Tube)	DBS-SA-1	03
Dynamic Bend Stiffener Steelwork Assembly (Ring and Spindle)	DBS-SA-2	03
XXXmm Active Diameter x XXXmm Active Length - PU Cone	DBS-1-XXX01	02
XXXmm OD x XXXmm ID x XXmm THK - Bolted Tube	DBS-1-XXX12	01
XXXmm OD x XXXmm ID - Flange and Tube Assembly (Ring And Spindle)	DBS-2-XXX01	01
MXX x XXXmm PCD - Spindle and Ring Assembly	DBS-2-XXX02	01
XXXmm OD x XXXmm ID - Flange and Tube Assembly (Bolted Tube)	DBS-2-XXX03	01
Technical Data Sheet BC-PU-108	BC-PU-108	11
Technical Data Sheet BC-PU-107	BC-PU-107	07
General Arrangement Drawing	15125-GA-01	03
Inspection and Test Plan	15125-PD-002-001	04
Production Test Report	15125-PD-010-001	02
Production Test Procedure: DBS Tensile Test Report	BGLR 15125-01	N/A

Bureau Veritas' approval of the above documents are detailed in Independent Appraisal Report 25ABD10825 Rev. 0.

4 Material Specifications:

Balmoral Comtec Ltd 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.

Component	Material
Bend Stiffener Active Section	Polyurethane (BC-PU-108 / BC-PU-107)
Internal Steelwork	Structural Steel (BS EN 10025-1 S355J2 + N, BS EN 10210 S355J2H + N, BS EN 10060 S355H2N Hot Rolled Bar) Inconel 625 UNS N06625 F65 (ASTM A694/A694M)
Fasteners	ASTM A320 Grade L7M (Studs) ASTM A194 Grade 7, 7M (Nuts) (or equivalent grades)

Test Procedures for Polymer materials to be according to standards specified in Table 5, API Specification 17L1: 2nd Edition.

Metallic material used for ancillary equipment and fasteners shall comply with the requirements of API Specification 17L1: 2nd Edition, Tables 6 and 7. Material data sheets provided by Balmoral Comtec Ltd satisfy the requirement.

5 Fabrication/Testing Procedures/QMS Audit Procedures:

API Specification 17L1: 2nd Edition, provides detailed procedures for performing factory acceptance tests (FATs). Balmoral Comtec Ltd document 15125-PD-002-001 Rev. 04 specifies the production test procedures for Bend Stiffener assemblies. Bureau Veritas have reviewed these documents and found them to be in accordance with the requirement.

Bureau Veritas conducted an audit to assess the quality management system (QMS) arrangements, and practices in place for design and manufacturing process of Bend Stiffeners at Balmoral Comtec Ltd. The audit was carried out on 16th & 17th of June 2025 and is detailed in Type Approval Audit Report No. 25ABD10479 Rev. 03.

As a result of the Type Approval Audit, it was concluded by the Auditor that Balmoral Comtec Limited have adequate systems in place which are in compliance with the specified regulations and standards.

6 Type Test reports/Laboratory Reports/Certificates:

Bureau Veritas has witnessed a sample of production tests for the approved type and the applicable requirements of API Specification 17L1: 2nd Edition as summarized in the following:

25ABD10707 Rev. 0 Witness Inspection Report

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 retention of the type approval certificate is subjected to satisfactory annual surveillance according to the plan provided in Appendix A.

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 Balmoral Comtec Ltd shall demonstrate all relevant documents including design reports, calculations, manufacturing and test documentation as applicable on a case-by-case basis for each project specific product.

10.2 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.

10.3 Balmoral Comtec Ltd shall notify Bureau Veritas to witness the next flex fatigue testing of the Bolted Tube design.

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				
S.No.	**ELEMENTS TO BE EXAMINED**	**Recertification**	**Surv. 1**	**Surv. 2**	**Surv. 3**	**Surv. 4**
		2025	*2026*	*2027*	*2028*	*2029*
1*	*QMS / Manual / Policy / Objectives (4.4, 5.2, 6.2)	✓	✓	✓	✓	✓
2*	*Management Review (9.3)	✓	✓	✓	✓	✓
3*	*Internal Audit (9.2)	✓	✓	✓	✓	✓
4*	*Improvement / Internal NCR Process (10)	✓	✓	✓	✓	✓
5*	*Customer Satisfaction /Requirements (9.1.2)	✓	✓	✓	✓	✓
6*	*Roles, Responsibilities Competency, & Training (5.3, 7.2)	✓	✓	✓	✓	✓
7	Resource Management (7.1.1, 7.1.2, 7.1.3, 7.1.4)	✓				
8	Design & Development (8.3)	✓				
9	Control of Documents (7.5)	✓				
10	Control of Records (7.5)	✓				
11	Customer Property (8.5.3)	✓				
12	Identification & Traceability (8.5.2)	✓				
13	Control of Product & Service Provision (8.5.1) (Process Control)	✓				
14	Inspection and Testing (8.3.4) #	✓				
15	Control of Monitoring & Measuring Equipment (7.1.5) (Calibration)	✓				
16	Operational Planning & Control (8.1, 8.2)	✓				
17	Control of Non-Conforming Product (8.7)	✓				
18	Preservation of Product (8.5.4)	✓				
19	Control of externally provided processes, products and services (8.4)	✓				
20	Responsibilities, Authority & Communication (5.3, 7.4)	✓				
	Assessor's initials	CM/GR				

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. S.No. 7 to 20 to be agreed with the Client for the respective surveillance visits.
5. # check Part (B) for Additional Elements

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

Design: Dynamic Bend Stiffener (BSR)

Activity	Status of ITP Activities	Witness Inspection Report
Witness Manufacturing Tests for Dynamic Bend Stiffener – Recertification 2025 Design: 15125-GA-01 Ring and Spindle ITP: 15125-PD-002-001	Completed	25ABD10707 Rev. 0

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