



Certificate Number: 15ABD10765 Rev. F
BV Job no.: 21ABD11657554

Page 1 of 7

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: 29/05/2025

Issued by: Bureau Veritas UK Limited Craigshaw Business Park Craigshaw Road AB12 3AR Aberdeen	Author: Charles STEWART Position: Lead Engineer	Approver: Rizwan MOHAMMED Position: Certification Manager
	Signature & Stamp 	Signature & Stamp 
	Date: 4 th March 2022	Date: 4 th March 2022

Certificate Revision History

Revision	Reason for Revision
0	Initial issue
A	Section 3 updated with additional reference document
B	Section 2 updated to highlight limitations for dynamic bend stiffener
C	Section 4 updated to highlight material specification for BSR spindle & ring assembly
D	Certificate renewal
E	Revision of standard
F	Revised to include BC-PU-107 material



This document has been prepared by Marine & Offshore Division of Bureau Veritas UK Limited on the basis of a contract for services made on terms and conditions agreed with the client to whom this document is issued. It is issued strictly on the basis of and subject to those terms and conditions. It has been compiled with all reasonable skill and care but may not be relied upon by any person who is not a party to the contract under which this document is issued. Marine & Offshore Division of Bureau Veritas UK Limited cannot accept any liability whatsoever to any third parties to whom this document may be copied or circulated.

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 Contact Temperature (WET Condition)	+ 60 °C	+ 70 °C
Maximum Design Contact 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:

21ABD10730 Rev. A

Complimentary Independent Appraisal Report

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

Title	Reference n°	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

Bureau Veritas' approval of the above documents are detailed in the complementary Independent Appraisal Report (21ABD10730 Rev. A).

4 Material Specifications:

Balmoral Comtec Limited 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.

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 S355 H2N 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:

API Specification 17L1: 2nd Edition, provides detailed procedures for performing factory acceptance tests (FAT)s. Balmoral Comtec Ltd document 14397-PD-002-001 Rev. 06, 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.

6 Type Test Reports/Laboratory Reports/Certificates:

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

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.



Certificate Number: 15ABD10765 Rev. F
BV Job no.: 21ABD11657554

Page 5 of 7

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 and calculations 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.

End of Certificate



This document has been prepared by Marine & Offshore Division of Bureau Veritas UK Limited on the basis of a contract for services made on terms and conditions agreed with the client to whom this document is issued. It is issued strictly on the basis of and subject to those terms and conditions. It has been compiled with all reasonable skill and care but may not be relied upon by any person who is not a party to the contract under which this document is issued. Marine & Offshore Division of Bureau Veritas UK Limited cannot accept any liability whatsoever to any third parties to whom this document may be copied or circulated.

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
	April 2020	April 2021	April 2022	April 2023	April 2024	April 2025
*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	CW	CES	CES			



Certificate Number: 15ABD10765 Rev. F
BV Job no.: 21ABD11657554

Page 7 of 7



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.

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

Design: Dynamic Bend Stiffener (BSR)

ITP References: 14397-PD-002-001

Year	Activity	ITP Activities
1 (2021)	Witness/Review Manufacturing Tests - Bend Stiffener	19-23
2 (2022)	Witness/Review Manufacturing Tests - Bend Stiffener	19-23
3 (2023)	Witness/Review Manufacturing Tests - Bend Stiffener	19-23
4 (2024)	Witness/Review Manufacturing Tests - Bend Stiffener	19-23

<p>Surveyor Y1: P. Michael Wilson</p>  <p>Charles E. Stewart</p> <p>BV Report No.: 21ABD10739 Rev. 0</p> <p>Date: 04/10/21</p>	<p>Surveyor Y2:</p>  <p>Charles E. Stewart</p> <p>BV Report No.: 21ABD1063 OREVO</p> <p>Date: 16/7/22</p>	<p>Surveyor Y3:</p> <p>BV Report No.:</p> <p>Date:</p>	<p>Surveyor Y4:</p> <p>BV Report No.:</p> <p>Date:</p>
---	--	--	--

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

End of Appendix