DNV·GL

Certificate No:
TAD00000DK

TYPE APPROVAL CERTIFICATE

This is to certify:

That the Marine Riser Equipment

with type designation(s)
2.0K Subsea FlexJoint

Issued to
Oil States Industries Inc.
ARLINGTON TX, United States

is found to comply with
DNVGL-OS-E101 – Drilling plant, Edition July 2015
DNVGL-SI-0166 – Verification for compliance with Norwegian shelf regulations, Edition July 2015

Application :

See Page 2

**** TAD00000DK replaces D-6054**

This Certificate is valid until **2021-06-15**.

Issued at **Houston** on **2016-06-16**

for **DNV GL**

DNV GL local station: **Houston - Systems & Components**

Approval Engineer: **Mark Miser**

Brandon D. Caraway
Head of Section

This Certificate is subject to terms and conditions overleaf. Any significant change in design or construction may render this Certificate invalid.
The validity date relates to the Type Approval Certificate and not to the approval of equipment/systems installed.

Job Id: **262.1-016460-3**
Certificate No: **TAD00000DK**

Product description

The 2.0K Subsea FlexJoint is marine drilling riser equipment that permits relative angular displacement of the drilling riser system elements without excessive bending stresses.

The following design codes/standards were used as references:

[1] API 16F, 'Specification for Marine Drilling Riser Equipment' 1st Edition
[2] ASME Boiler & Pressure Vessel Code, Section VIII, Division 2, 2010,"Rules for Construction of Pressure Vessels"

Application/Limitation

Design Parameter	Value	(Equivalent)
• Rated Axial Tensile Load	: 2.0 x 10^6 lb_f	(8,896.4 kN)
• Rated Axial Compressive Load	: 0 lb_f	(0 kN)
• Rated Working Pressure	: 2,000 psi	(137.9 bar)
• Hydrostatic Test Pressure	: 3,000 psi	(206.8 bar)
• Minimum Design Temperature	: -4°F	(-20 °C)
• Maximum Design Temperature	: 446 °F for 7 days	(230 °C for 7 days)
	: 77 °F for 300 years	(25 °C for 300 years)
• Combined Loading Condition #1	: 2,000 psi pressure	(137.9 bar)
	: 1.0 x 10^6 lb_f tension	(4,448.2 kN)
	: ± 10 ° Conical rotation	
• Combined Loading Condition #2	: 0 psi pressure	(0 bar)
	: 2.0 x 10^6 lb_f tension	(8,896.4 kN)
	: ± 10° Conical rotation	
• Hydrostatic Test Loading	: 3,000 psi pressure	(206.8 bar)
	: 0 lb_f tension	(0 kN)
	: ± 0 ° Conical rotation	
• Maximum Flex Angle	: ± 10 ° Conical rotation	
• System, Equipment, Service	: Well Control System, Marine Drilling Riser Equipment, Sour (H_2S)	

Design Limitation Note: Customer supplied Riser Couplings shall be provided with DNV GL Product Certification and may reduce the indicated design limitations.

Type Approval documentation

Other part numbers or updated revisions may be acceptable under this Certificate provided critical aspects of the design remain the same. Changes shall be documented and approved (via Engineering Change Notice or similar) by the Manufacturer's Engineering and/or Quality department as appropriate. DNV GL's local surveyor shall verify the change before issuance of Product Certificate.

The following drawings are approved:

Dwg. No.	Rev	Title
PD7685	C	2.0K Riser FlexJoint Assembly w/ 18 ¾ 5000 Flanges
PD7950	A	2.0K Riser FlexJoint Assembly w/ 16 ¾ 5000 Flanges
PD10548	A	2.0K Riser FlexJoint Assembly w/ 20¼ 5000 Flange & 20¼ 2000 Flange
PD7713	C	Weldment 18 ¾ - 5000 Flange
PD8044	C	Weldment 16 ¾ - 5000 Flange
PD10635	NC	Weldment 20¼ 2000 Flange
PD2343	D	Molded Assembly

Dwg. No.	Rev	Title
PD2264	J	Nipple
PC1874	A	Spherical Reinforcements
PD2263	J	Back Flange
PD7373	E	Back Flange
PD2262	H	Retainer Flange
PD2344	W	Body w/ Replaceable Parts
PD2417	H	Upper Flange
PD7417	B	Upper Flange
PD10637	NC	Upper Flange
PD2229	E	Wear Ring
PD2230	A	Wear Ring
PD2680	N	Lower Wear Sleeve
PD10636	NC	Lower Wear Sleeve
PC3715	E	Upper Wear Sleeve
PC7416	NC	Upper Wear Sleeve
PD2156	M	Ring Groove Insert, Stanless Steel
PD8143	NC	Ring Groove Insert, Inconel
PB2266	F	Retainer Stud
PB17104	A	Modified Retainer Stud
PB2265	F	Retainer Nut
PD3620	E	Urethane Debris Shield
PB0849	E	Anti-rotation Pin
PB0982	B	Wear Ring Pin
PB0977	A	O-Ring Flex Element
PB2163	A	O-Ring Groove insert
PB2164	C	O-Ring Wear Sleeve
PB1147	C	Test Port Plug

Note : Customer supplied Riser Couplings shall be provided with DNV GL Product Certification.

The following calculations are for information:

Design Calculations:

Title	Rev	Date
Technical Report SP1E-23-128, ABAQUAS Stress Analysis Report for 2.0K Subsea FlexJoint	B	2010

The following material specifications are presented for information:

Material Specifications:

Spec.	Rev	Material	Min Yield	Req'd. Charpy
		ASTM A36	36,000 psi	N.A.
SP 1B-00-002 Gr III	U	AISI 4130	60,000 psi	31 ft-lb_f at -25 °F
SP 1B-00-002 Gr IV	U	AISI 4130	60,000 psi	31 ft-lb_f at-40° F
Stud PB2266	F	ASTM A320-L7 or A193-B7	105,000 psi	20 ft-lb_f at-50° F
Stud PB17104	A	ASTM A320-L7 or A193-B7	105,000 psi	20 ft-lb_f at-50° F
Nut PB2265	F	ASTM A194 Gr. 7	N.A.	N.A.

Tests carried out

1. Prototype testing, as documented by DNV GL reports ANMUS476PP002832emay20110823D, ANMUS476PP002832jdun20110608A, ANMUS476PP002832jdun20110615A and ANMUS476PP002832wdd6july2011A, was found to be acceptable in accordance with normative reference API 16F, 1st Edition §8.6.
2. Procedures related to testing, welding, NDT, etc are to be reviewed/approved by DNV GL's local surveyor

Marking of product

Marking shall:

1. Be reviewed and approved by the DNV GL local surveyor.
2. Identify and differentiate each production unit <i.e. serial number>.
3. Establish traceability to product design and fabrication documentation.
4. Be in accordance with API 16F (Ref. 1st Edition §8.7).

Comments

None

Periodical assessment

For retention of the Type Approval, DNV GL's surveyor shall perform a survey every second year in accordance with DNV GL Type Approval Scheme DNVGL-CP-0338, October 2015 Edition.

END OF CERTIFICATE