SHELL GLOBAL SOLUTIONS

CERTIFICATE OF ACCEPTANCE

This is to certify that a seal design approval has been awarded to:

Company: Precision Polymer Engineering Ltd
Manufacturing Location: Blackburn, UK and Brenham, TX
Brand: EnDura V91K
Technical Qualification Result: Successful Type Acceptance Test

Based on the Shell Global Solutions Technical Qualification, the performed Type Acceptance Testing (TAT) in accordance with testing procedure SPE 85/300 (dated February 2017) has been accepted in January 2018 by Shell Global solutions International B.V. based on successful TAT result of:

Seal type	Toroidal O-ring. For other types, see seal description sheet on next page.
Seal material	Fluorocarbon terpolymer (FKM) compound
General Seal description	The EnDura V91K complies with the temperature performance and rapid gas decompression (RGD) resistance requirements and complies with the typical FKM tolerance for H2S, aromatics and hot water.
Restrictions & Conditions	The use of the EnDura V91K is restricted to a temperature range of -30 °C to maximum 150 °C and is for elastomeric sealing applications.

Shell GSI Report No: N.A. (Not Applicable)	**Original acceptance**: January 29, 2018
Shell GSI contract no: N.A.	**Current Certificate**: January 29, 2018
Certificate Revision: 0	**Certificate Expiry**: January 29, 2023
Issued By: Shell Global Solutions International B.V. GSNL-PTE/EMMI – Bas van der Heijden Bas.vanderHeijden@shell.com	**Suppliers Report No.:** Test Certificate for RGD test by Element Materials Technology with contract reference C4519, dated 14th August 2017 Test Certificate for Sour Fluid Resistance by Element Materials Technology, dated 22nd Dec. 2014 Test Result for Sour Fluid Resistance provided by MCC with sample ref. 3414. **Suppliers Contact:** Hill, Jamie jhill3@idexcorp.com

Signature / Stamp:

Bas van der Heijden

Date: January 29, 2018

EnDura® V91K Specification

Rev.0

Testing in Accordance with Shell MESC SPE 85/301 2017

Production Location: Blackburn, UK and Brenham, TX

Product Description: Peroxide Cured FKM

Product Application Area: O-rings, S-Seals, T-Seals, Packers and Chevron Stacks

Product Conditions: Up to 40,000 psi and beyond dependant on application. Temperature:-41°to 225°C

Testing in Accordance with Shell MESC SPE 85/301 2017				
Basic Mechanical Properties				
Property	Test Method	Result	Requirement from Shell MESC SPE 85/301	Testing Location
Hardness	ASTM D1415	91 IRHD	85 to 95 Shore A	Average of 30 batches tested at PPE
Tensile Strength	ASTM D412	24.5 MPa	10.3 MPa Minimum	Average of 30 batches tested at PPE
Tensile Stress	ASTM D412	7.3 MPa	4.0 MPa at 50% Elongation	Average of 30 batches tested at PPE
		15.9 MPa	7.9 MPa at 50% Elongation	Average of 30 batches tested at PPE
Elongation	ASTM D412	149%	70 % to 250 %	Average of 30 batches tested at PPE
Compression Set	ASTM D395 Method B	12% After 24 hours at 200°C	30% after 24 hours at 150°C	Average of 30 batches tested at PPE
Low Temperature Retraction (TR10)	ASTM D1329	-33°C	Maximum -30°C	Akron Rubber Development Laboratory, Inc

NORSOK M710 Annex A rev. 2						
Gas Composition	Volume (%)	Composition				
	30	2% Hydrogen sulfide, 3% Carbon dioxide, 95% Methane				
	10	100 % Distilled Water (de-ionised)				
	60	70% Heptane, 20% Cyclohexane, 10% Toluene				
Pressure	100 bar	-				
PPE Testing Conditions					MESC SPE 85/301 Requirements	
Temperature	200 °C	175°C	150°C	121°C	80°C	150°C
Time	168 hours	1296 hours	1344 hours	1200 hours	24 hours	24 hours
Results	Hardness (Change in IRHD)	Volume Change (%)	Elongation at Break Change (%)	Tensile Strength Change (%)	Modulus @100% Change (%)	Testing Location
200°C	-18	8.0	31	-40	-49	Materials Engineering Research Laboratory LTD (MERL), [now Element Materials Technology Hitchen LTD]
175°C	-20	22.2	-20	-15	11	
150°C	-13	9.1	10	5	-5	
121°C	-6	8.2	17	-32	-37	
NORSOK Criteria	+10/-20	+25/-5%	+/-50	+/-50	+/-50	
Pass/Fail	Pass	Pass	Pass	Pass	Pass	

NORSOK M710 Annex A rev. 3 as modified by MESC SPE 85/301		
Test Conditions		
Temperature	150°C	
Pressure	150 bar	
Gas	10% Carbon dioxide, 90% Methane	
No. of Cycles	8	
Test seal replication	4	
Cycle 1 soak time	72 hours	
Cycle 2-8 soak time	6 hours minimum	
Dwell Time between cycles	60 minutes	
Decompression Rate	20 bar/minute	
Result	0000	Pass