

Allen, William

From: Sarah Bryson <sarah.bryson@croftltd.com>
Sent: Monday, December 16, 2013 10:38 AM
To: Allen, William
Cc: Bob Vaughan
Subject: RE: DU and O-Ring Requests
Attachments: References.pdf

Dear Chris,

Firstly some good news we have carried out the vibration testing and the inserts passed. That is to say they were leaktight on completion of the vibration tests, so we are now in a position to resubmit the SAR with the corrections suggested. However we do still have the 2 outstanding issues regarding the DU and O-rings to bottom out so we can move towards getting the HS SAR approved. As such please see my responses to your questions below:

1. The tests were carried out at room temperature in accordance with ASTM A370, the Charpy test standard.
2. The drop tests were carried out with the package cooled to -40°C
3. The DU is more brittle at -40°C. I have attached the mechanical properties of 2% Mo DU to this email so you can see the changes in the impact properties verses the temperature. This table comes from the paper The mechanical properties of Depleted Uranium 2 w/o Molybdenum alloy, Battelle, Columbus Laboratories produced for the DOE.
4. The testing for the fabricated O-rings was introduced because the published properties of EPM did not cover the temperature range given in the SAR. The material was only rated to 150oC for NCT conditions and 200oC for HAC which was below the temperature reached during NCT (151°C) and HAC (210°C) tests therefore we had to introduce the O-ring tests to qualify the O-rings to these higher temperatures. Viton GLT is rated up to 200°C (please see the sheet in the references pdf). As part of the O-ring procurement the O-ring material will be tested to ensure that it meets the ASTM D2000 line call outs which now include a heat resistant test at 250°C and a compression set test at 200°C. (Line call out reference table attached). Therefore any further qualification tests we carried out for the EPM O-rings is not required for Viton GLT.

If you feel a teleconference would be helpful both Bob and myself are in the office until Thursday.

Thank you,
Sarah

Sarah Bryson

Licensing Engineer

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From: Allen, William [<mailto:William.Allen@nrc.gov>]

Sent: 11 December 2013 19:19

To: Sarah Bryson

Cc: Bob Vaughan

Subject: DU and O-Ring Requests

Relative to the information and requests you provided in your November 21 e-mail, we are requesting the following information:

1. Please provide the temperature at which the Charpy value of 7.8 achieved in tests of the depleted uranium was obtained.
2. Please provide the temperature at which the drop tests used to validate the package was conducted.
3. Explain if the depleted uranium performance is either more brittle or more ductile at the temperature provided in question 2 versus the temperature provided in question 1.
4. Provide a justification for not testing the as fabricated O-rings per Section 8.1.5.2.

Please contact me if you have any questions or concerns.

Thanks, Chris

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TABLE 6. IMPACT TEST RESULTS
FOR U-2Mo CASTING

Specimen	Impact Energy, ft/lb
<u>-40 F</u>	
15	4.5
16	4.5
Average	<u>4.5</u>
<u>-20 F</u>	
12	6.0
13	5.0
14	5.0
Average	<u>5.3</u>
<u>0 F</u>	
9	5.0
10	6.5
11	7.0
Average	<u>6.2</u>
<u>32 F</u>	
7	7.0
8	8.0
Average	<u>7.5</u>
<u>Room Temperature</u>	
3	9.5
4	8.5
5	8.5
6	8.5
Average	<u>8.8</u>
<u>200 F</u>	
1	14.5
2	13.5
Average	<u>14.0</u>

Precision Polymer Engineering Ltd			
Material Data Sheet	Code	V75T	
	Designation	FKM / FPM	August 2001

MATERIAL TYPE: Peroxide cured, Fluoroelastomer Rubber, 70-80 IRHD.
Tetrapolymer of vinylidene fluoride, perfluoromethyl vinyl ether, tetrafluoroethylene plus cure site monomer (CSM). Formulated using Viton® GLT. Viton® is a registered trademark of Dupont®.
ASTM designation = FKM. ISO designation = FPM.

APPLICATION: Recommended for use in static or dynamic applications where low temperature performance is required. Chemical resistance is similar to that of standard fluoroelastomer. Low temperature performance superior to other grades of fluoroelastomer.

TEMPERATURE RANGE: Maximum operating temperature +200°C (392°F).
Minimum operating temperature -40°C (-40°F).

SHELF LIFE CLASSIFICATIONS: Initial storage = 10 years, extended storage = 5 years.

TYPICAL PHYSICAL PROPERTIES:			
Property	Unit	Test method	Value
Hardness (points)	°IRHD	ASTM D1415 (=ISO 48)	75
Tensile strength	Mpa	ASTM D412 (=ISO 37)	17.9
Elongation at break	%	ASTM D412 (=ISO 37)	150
Compression Set, Method B; 24 hours at 200°C (392°F)	%	ASTM D395 (=ISO 815)	20
Heat Resistance; 72 hours at 250°C (482°F)		ASTM 573 (=ISO 188)	
Hardness change (points)	°IRHD	ASTM D1415 (=ISO 48)	-4
Tensile strength change	%	ASTM D412 (=ISO 37)	-20
Elongation at break change	%	ASTM D412 (=ISO 37)	+15

COSHH HEALTH AND SAFETY DATA: No known hazard exists if used in accordance with the temperature range as quoted.

FIRE HAZARD: Ignition temperature >315°C (599°F). Thermal decomposition will generate; hydrogen fluoride, fluorinated hydrocarbons, carbon monoxide and carbonyl fluoride. In the event of fire, fire fighters must wear self-contained breathing apparatus and a protective suit. Extinguish with water, foam, carbon dioxide or dry chemical. Neutralise any refuse from a fire involving fluoroelastomer with calcium hydroxide solution and wear Neoprene® gloves before handling.

DISPOSAL: Must conform to national, state and/or local regulations. Landfill is recommended. Burning is not recommended, unless conducted by an approved/licensed incineration agency.

SPECIAL NOTE: This information is to the best of our knowledge accurate to the date indicated. However, PPE make no warranty, expressed or implied, that parts manufactured from this material will perform satisfactorily in the customer's application. It is the customer's responsibility to evaluate parts prior to use, especially in applications where their failure may result in injury and/or damage. It should also be noted that all elastomeric parts have a finite life, therefore a regular program of inspection and replacement is strongly recommended.

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ASTM D2000-12 Line Call-outs for Viton GLT

M2 HK 810 A1-10 B38 F15 Z1 Z2

where Z1 stands for hardness of $75 \pm$ IRHD (or Shore A) and Z2 stands for low temperature resistance, test methods D2137, method C, 9.3.3 non brittle after 3 mins at -40°C .

Ref	Item	Sub-item	ASTM D 2000 Ref	Meaning	Requirement	Comments (references are to ASTM D 2000)	Test Requirement	
a	M2	M	Para 4.1	Metric		Classification system based on SI units	None	
b		2	Para 5.1	Grade#	Tests listed for HK materials in Table 6, (Page 51)	The required tests from the list are defined by the Suffix specs as below	None	
c	HK	H	Table 1	Type (by temperature)	250°C test temp	Fluoroelastomer meets HK material designation – see Table X1.1(Page53)	Test to verify that the material is Fluoroelastomer	
		K	Table 2	Class (by volume swell)	No requirement			
d	810	8	Para 4.5	Hardness	80 ± 5 Durometer	Overridden by Z1 which specifies 75 ± 5	None	
e		10	Para 4.5	Minimum tensile strength	10 MPa	For hardness 80 and 10MPa	Test to verify minimum tensile strength is 10 MPa and minimum ultimate elongation of 150%	
			Table 6, Page 50	Ultimate Elongation, min	150%			
	Suffix Specs	Suffix Letter	Suffix#	The suffix specs below define the required tests from Table 6 (Page 51) for Grade 3, HK Materials				
f	A1-10	A		Table 3	Heat resistance test		Test to verify heat resistance requirements are met.	
		1		Table 5	Test temperature	D573 70h		From Table 6, Page 51
		10		Table 4	Test temperature	250°C		
g	B38	B		Table 3	Compression set test		Test to verify compression set test requirements are met	
		3		Table 5	Test method	D395, Method B, max, %, 22h,		From Table 6, Page 51
		8		Table 4	Test temperature	200°C		
h	F15	F		Table 3	Low temperature resistance		Test to verify low temperature resistance requirements are met.	
		1		Table 5	Test method	D2137, Method C, 9.3.3, non brittle after 3mins		From Table 6, Page 51
		5		Table 4	Test temperature	-25°C		
j	Z1	Z	1	Table 5	Hardness of 75 ± 5 IRHD (or shore A)	D2240	Test to verify the hardness is 75 ± 5 IRHD (or shore A)	
k	Z2	Z	2	Table 5	F15 test temperature; -40°C	D2137, Method C, 9.3.3, non brittle after 3mins	F15 test temperature changed from -25°C to -40°C . Test to verify low temperature resistance requirements are met.	

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21/11/2013

Viton GLT ASTM D2000 Line Call-Rev3.docx