RTG	Ball Latch Valve Radiation Test Summary	DocNo.: 430-BLV-M-015 Issue: 01 Date: 04.06.2012 Page: 1 of 6
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Abbreviations

BLV	Ball Latch Valve
GSE	Ground Support Equipment

References

[RD 1]	RTG, Component Description, 430-BLV-TN-001.06
[RD 2]	RTG, Delta-Qualification Test Procedure and Report, 430-S3-Q-002.07
[RD 3]	ESA, Radiation Summary, (08/03/2010)



1 Introduction

This document is the summary of RTG' Ball Latch Valve Component Description [RD 1] and of the Delta-Qualification Test Procedure and Report [RD 2]. It has been established for publication on ESCIES.

2 Scope

In the scope of the requalification of the Ball Latch Valve, a radiation test was performed in order to qualify the proximity switches without LED (DW-AD-403-M5-012-ESA). It was carried out at the Co-60 facility owned by ESTEC / ESA in Nordwijk [RD 3].

Since it was not possible to test these at component level, it was decided to test them as assembled part. For this purpose, two additional switches were mounted on the qualification model before the test in order to be more representative.

3 **Procedure**



The radiation test did take place at ESTEC in the radiation facility. Prior to any testing, 2 additional proximity switches (DW-AD-403-M5-012-ESA) had been mounted on the



valve. They were not calibrated, but it has been assured that their signal change is comparable to the nominal sensors.

The valve has been installed in the radiation chamber (no pressure supply - ambient conditions) and subsequently subjected to a total dose of 20 krad minimum at a rate of 449 rad/hour (tolerance of \pm -2 rad/hour). Once the total dose had been reached, the radiation source had been closed. The valve had no internal pressure during the test.

The proximity switches were supplied with 15 VDC and their output voltage and input current signal recorded during the whole radiation test.

At the indicated red points in the figure above (Fig.4-4) functional tests had been performed. For each one, the valve shall be actuated 4 times, motor and proximity switches voltage and current had been recorded.

After the radiation total dose was achieved, the two previously mounted sensors were removed and baked out in an oven at 70°C for 5 days. Their voltage and current signal had been then checked on a manual test bench.

Requirements:

 $\begin{array}{l} BLV.QM-REQ-4.18.1 - I_{in} \leq 1,5 \mbox{ A at any time.} \\ BLV.QM-REQ-4.18.2 - I_{nom} \leq 75 \mbox{ mA (average)} \\ BLV.QM-REQ-4.18.3 - 3s \leq (t_0 ; t_C) \leq 5s \\ BLV.QM-REQ-4.18.4 - U_{01} = U_{02} = 0\text{-}4 \mbox{ VDC when valve open} \\ BLV.QM-REQ-4.18.5 - U_{01} = U_{02} = 10\text{-}15 \mbox{ VDC when valve closed} \\ BLV.QM-REQ-4.18.6 - switch current signal shall not be above 200mA \\ BLV.QM-REQ-4.18.7 - the valve shall not show any sign of damage \\ BLV.QM-REQ-4.18.8 - at least 20.000 \mbox{ rad total dose exposure shall be achieved} \\ at valve level \\ BLV.QM-REQ-4.18.9 - an external test report shall be written \end{array}$

4 Test Results

Functional test 1		0 rad	
BLV.QM-REQ-4.18.1 - inrush current	≤ 1,5	0,90	А
BLV.QM-REQ-4.18.2 - nominal current	≤ 75	50	mA
BLV.QM-REQ-4.18.3 - actuation time	$3 \le t \le 5$	3,73	s
BLV.QM-REQ-4.18.4 - sensor low signal	0	0	VDC
BLV.QM-REQ-4.18.5 - sensor high signal	14 +/- 1	13,7	VDC
BLV.QM-REQ-4.18.6 - switch current signal	< 200	62,8	mA
in-between		2,2 hours	
in-between BLV.QM-REQ-4.18.4 - sensor low signal	0	2,2 hours 0	VDC
in-between BLV.QM-REQ-4.18.4 - sensor low signal BLV.QM-REQ-4.18.5 - sensor high signal	0 14 +/- 1	2,2 hours 0 13,7	VDC VDC
in-between BLV.QM-REQ-4.18.4 - sensor low signal BLV.QM-REQ-4.18.5 - sensor high signal BLV.QM-REQ-4.18.6 - switch current signal	0 14 +/- 1 < 200	2,2 hours 0 13,7 59,1	VDC VDC mA
in-between BLV.QM-REQ-4.18.4 - sensor low signal BLV.QM-REQ-4.18.5 - sensor high signal BLV.QM-REQ-4.18.6 - switch current signal	0 14 +/- 1 < 200	2,2 hours 0 13,7 59,1	VDC VDC mA
 in-between BLV.QM-REQ-4.18.4 - sensor low signal BLV.QM-REQ-4.18.5 - sensor high signal BLV.QM-REQ-4.18.6 - switch current signal Functional test 2 	0 14 +/- 1 < 200	2,2 hours 0 13,7 59,1 1.047 rad	VDC VDC mA
 in-between BLV.QM-REQ-4.18.4 - sensor low signal BLV.QM-REQ-4.18.5 - sensor high signal BLV.QM-REQ-4.18.6 - switch current signal Functional test 2 BLV.QM-REQ-4.18.1 - inrush current 	$ \begin{array}{c} 0 \\ 14 + - 1 \\ < 200 \end{array} $ $ \leq 1.5 $	2,2 hours 0 13,7 59,1 1.047 rad 0,90	VDC VDC mA



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BLV.QM-REQ-4.18.3 - actuation time	$3 \le t \le 5$	3,71	S
BLV.QM-REQ-4.18.4 - sensor low signal	0	0	VDC
BLV.QM-REQ-4.18.5 - sensor high signal	14 +/- 1	13,7	VDC
BLV.OM-REO-4.18.6 - switch current signal	< 200	61,9	mA
		,	
in-between		15.92 hours	
BLV.OM-REO-4.18.4 - sensor low signal	0	0	VDC
BLV.OM-REO-4.18.5 - sensor high signal	14 +/- 1	13.8	VDC
BLV OM-REO-4 18.6 - switch current signal	< 200	58.8	mA
	200	20,0	
Functional test 3		8.314 rad	
BLV OM-REO-4 18 1 - inrush current	< 1.5	0.90	А
BLV.QM/REQ.4.18.2 - nominal current	< 75	51	mΔ
BLV.QM-REQ.4.18.2 - nonlinear current BLV.QM PEO.4.18.2 - actuation time	$\frac{-75}{3 < t < 5}$	3 73	nn a
BLV OM PEO 4 18 4 sonsor low signal	$\int \underline{\langle} t \underline{\langle} J $	5,75	NDC
DLV.QWI-KEQ-4.10.4 - Sensor high signal	14 ± 1	0	VDC
DLV.QWI-REQ-4.18.5 - sensor high signal	14 +/- 1	15,/	VDC
BLV.QM-REQ-4.18.6 - switch current signal	< 200	61,8	mA
in hotmoon		2.56 hours	
In-Detween	0	2,50 nours	VDC
BLV.QM-REQ-4.18.4 - sensor low signal		0	VDC
BLV.QM-REQ-4.18.5 - sensor high signal	14 +/- 1	13,8	VDC
BLV.QM-REQ-4.18.6 - switch current signal	< 200	58,8	mA
Functional test 4		9.662 rad	
BLV.QM-REQ-4.18.1 - inrush current	$\leq 1,5$	0,90	А
BLV.QM-REQ-4.18.2 - nominal current	≤ 75	47	mA
BLV.QM-REQ-4.18.3 - actuation time	$3 \le t \le 5$	3,70	S
BLV.QM-REQ-4.18.4 - sensor low signal	0	0	VDC
BLV.QM-REQ-4.18.5 - sensor high signal	14 +/- 1	13,7	VDC
BLV.QM-REQ-4.18.6 - switch current signal	< 200	61,7	mA
in-between		4,08 hours	
BLV.QM-REQ-4.18.4 - sensor low signal	0	0	VDC
BLV.QM-REQ-4.18.5 - sensor high signal	14 +/- 1	13,8	VDC
BLV.QM-REQ-4.18.6 - switch current signal	< 200	58,8	mA
Functional test 5		11.608 rad	
BLV.QM-REQ-4.18.1 - inrush current	$\leq 1,5$	0,89	А
BLV.QM-REQ-4.18.2 - nominal current	≤ 75	48	mA
BLV.OM-REO-4.18.3 - actuation time	$3 \le t \le 5$	3,71	s
BLV.OM-REO-4.18.4 - sensor low signal	0	0	VDC
BLV.OM-REO-4.18.5 - sensor high signal	14 +/- 1	13.7	VDC
BLV OM-REO-4 18 6 - switch current signal	< 200	61.6	mA
	200		
in-between		16.19 hours	
BLV OM-REO-4 18 4 - sensor low signal	0		VDC
BLV.QM REQ. 4.18.5 - sensor high signal	14 + 1	13.8	VDC
BLV.QW-REQ.4.18.6 switch current signal	< 200	58.8	wDC mA
DL V.QWI-KLQ-4.18.0 - Switch current signal	< 200	50,0	
Functional test 6		19.023 rad	
BLV OM-REO-4 18 1 - inrush current	< 1.5	0.90	Δ
BLV OM-REO-4 18 2 - nominal current	< 75	47	mA
BLV $OM_REO_1 18.3$ - actuation time	$\frac{1}{3} < t < 5$	3 69	e
BLV OM_REO 4 18 4 sensor low signal		0	VDC
$\mathbf{PI} \mathbf{V} \mathbf{O} \mathbf{M} \mathbf{PE} \mathbf{O} \mathbf{A} 195 = \operatorname{souscer} \mathbf{h} \operatorname{sch} \mathbf{s} \operatorname{souscer} \mathbf{h} \mathbf{a}$	$1/1 \pm 1$	13 7	VDC
DLV. $QWI-REQ-4.10.5 - sensor mign signal DLV OM DEO 4.18 (available av$	$ \frac{14}{200} + \frac{1}{10} = 1$	13,7	
BLV.QWI-KEQ-4.18.0 - SWITCH current signal	< 200	01,/	mA
in botwoon		2.08 hours	
BIVOM DEO 4 18 4 consor low signal	0		VDC
DEV.QMITNEQ-4.10.4 - SCHSULIUW SIGHAL			



BLV.QM-REQ-4.18.5 - sensor high signal	14 +/- 1	13,8	VDC
BLV.QM-REQ-4.18.6 - switch current signal	< 200	58,9	mA
Functional test 7		20.111 rad	
BLV.QM-REQ-4.18.1 - inrush current	≤ 1.5	0,90	А
BLV.QM-REQ-4.18.2 - nominal current	≤ 75	47	mA
BLV.QM-REQ-4.18.3 - actuation time	$3 \le t \le 5$	3,69	s
BLV.QM-REQ-4.18.4 - sensor low signal	0	0	VDC
BLV.QM-REQ-4.18.5 - sensor high signal	14 +/- 1	13,7	VDC
BLV.OM-REO-4.18.6 - switch current signal	< 200	61,6	mA
		,	
in-between		1.99 hours	
BLV.OM-REO-4.18.4 - sensor low signal	0	0	VDC
BLV.OM-REO-4.18.5 - sensor high signal	14 +/- 1	13.8	VDC
BLV.OM-REO-4.18.6 - switch current signal	< 200	58.8	mA
		, -	
Functional test 8		21.122 rad	
BLV OM-REO-4 18 1 - inrush current	< 1.5	0.90	А
BLV OM-REO-4 18 2 - nominal current	< 75	46	mA
BLV OM-REO 4 18 3 - actuation time	$\frac{1}{3} < t < 5$	3 70	s
BLV.QM REQ 110.5 detaution time BLV OM-REO-4 18.4 - sensor low signal	0	0	VDC
BLV.QM REQ 110.1 sensor low signal	14 + - 1	13.7	VDC
BLV.QM REQ 4.10.5 Sensor men signal	< 200	61 7	w∆ m∆
DEV.QW-REQ-4.10.0 - Switch current signal	< 200	01,7	ma
BLV OM-REO-4 187 - no damage	(ok)	ok	
BLV OM DEO 4 18.8 total dosa	20.000	21502 (concore)	rad
DE V. QM-IXEQ-4.10.0 - 10101 0050	20.000	21.302 (selisors) 23.200 (motor)	rad
BLV OM REO / 18.9 evt report	ext report	Radiation Summer	Tau
$D = v \cdot Q v \cdot A = Q - 4.10.9 - C x \cdot 10 + 001$	ext. report		

During the test, in order to have an uniform irradiation of all sensors, the valve was leaned forward to face the radiation source:

