





**Ball Latch Valve  
Radiation Test Summary**

Doc.-No.: **430-BLV-M-015**  
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**DOCUMENT CHANGE RECORD**

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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

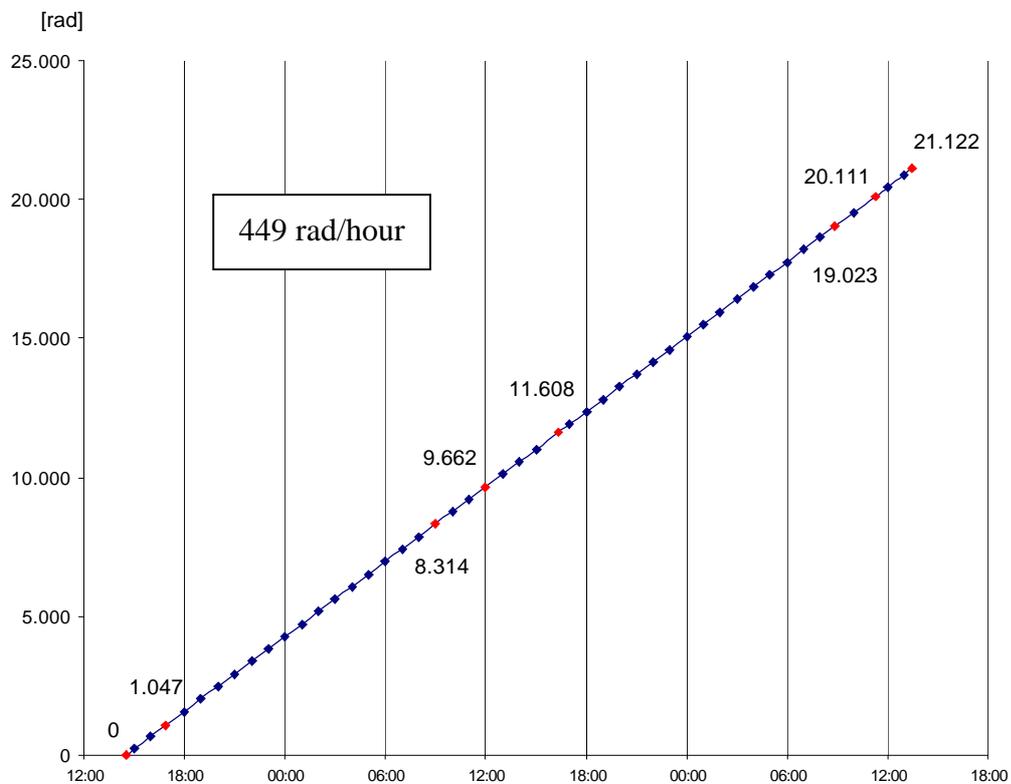
This document is the summary of RTG' Ball Latch Valve Component Description [RD 1] and of the Delta-Qualification Test Procedure and Report [RD 2]. It has been established for publication on ESCIES.

## 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



**Fig. 4-4 - Radiation levels**

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



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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 +/-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:

- BLV.QM-REQ-4.18.1 -  $I_{in} \leq 1,5$  A at any time.
- BLV.QM-REQ-4.18.2 -  $I_{nom} \leq 75$  mA (average)
- BLV.QM-REQ-4.18.3 -  $3s \leq (t_o ; t_c) \leq 5s$
- BLV.QM-REQ-4.18.4 -  $U_{01} = U_{02} = 0-4$  VDC when valve open
- BLV.QM-REQ-4.18.5 -  $U_{01} = U_{02} = 10-15$  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 rad total dose exposure shall be achieved at valve level
- BLV.QM-REQ-4.18.9 - an external test report shall be written

## 4 Test Results

<b>Functional test 1</b>		<b>0 rad</b>	
BLV.QM-REQ-4.18.1 - inrush current	$\leq 1,5$	0,90	A
BLV.QM-REQ-4.18.2 - nominal current	$\leq 75$	50	mA
BLV.QM-REQ-4.18.3 - actuation time	$3 \leq t \leq 5$	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
<b>in-between</b>		<b>2,2 hours</b>	
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	59,1	mA
<b>Functional test 2</b>		<b>1.047 rad</b>	
BLV.QM-REQ-4.18.1 - inrush current	$\leq 1,5$	0,90	A
BLV.QM-REQ-4.18.2 - nominal current	$\leq 75$	49	mA



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BLV.QM-REQ-4.18.3 - actuation time	$3 \leq t \leq 5$	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.QM-REQ-4.18.6 - switch current signal	< 200	61,9	mA
<b>in-between</b>		<b>15,92 hours</b>	
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
<b>Functional test 3</b>		<b>8.314 rad</b>	
BLV.QM-REQ-4.18.1 - inrush current	$\leq 1,5$	0,90	A
BLV.QM-REQ-4.18.2 - nominal current	$\leq 75$	51	mA
BLV.QM-REQ-4.18.3 - actuation time	$3 \leq t \leq 5$	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	61,8	mA
<b>in-between</b>		<b>2,56 hours</b>	
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
<b>Functional test 4</b>		<b>9.662 rad</b>	
BLV.QM-REQ-4.18.1 - inrush current	$\leq 1,5$	0,90	A
BLV.QM-REQ-4.18.2 - nominal current	$\leq 75$	47	mA
BLV.QM-REQ-4.18.3 - actuation time	$3 \leq t \leq 5$	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
<b>in-between</b>		<b>4,08 hours</b>	
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
<b>Functional test 5</b>		<b>11.608 rad</b>	
BLV.QM-REQ-4.18.1 - inrush current	$\leq 1,5$	0,89	A
BLV.QM-REQ-4.18.2 - nominal current	$\leq 75$	48	mA
BLV.QM-REQ-4.18.3 - actuation time	$3 \leq t \leq 5$	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.QM-REQ-4.18.6 - switch current signal	< 200	61,6	mA
<b>in-between</b>		<b>16,19 hours</b>	
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
<b>Functional test 6</b>		<b>19.023 rad</b>	
BLV.QM-REQ-4.18.1 - inrush current	$\leq 1,5$	0,90	A
BLV.QM-REQ-4.18.2 - nominal current	$\leq 75$	47	mA
BLV.QM-REQ-4.18.3 - actuation time	$3 \leq t \leq 5$	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.QM-REQ-4.18.6 - switch current signal	< 200	61,7	mA
<b>in-between</b>		<b>2,08 hours</b>	
BLV.QM-REQ-4.18.4 - sensor low signal	0	0	VDC



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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
<b>Functional test 7</b>		<b>20.111 rad</b>	
BLV.QM-REQ-4.18.1 - inrush current	≤ 1,5	0,90	A
BLV.QM-REQ-4.18.2 - nominal current	≤ 75	47	mA
BLV.QM-REQ-4.18.3 - actuation time	3 ≤ t ≤ 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.QM-REQ-4.18.6 - switch current signal	< 200	61,6	mA
<b>in-between</b>		<b>1,99 hours</b>	
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
<b>Functional test 8</b>		<b>21.122 rad</b>	
BLV.QM-REQ-4.18.1 - inrush current	≤ 1,5	0,90	A
BLV.QM-REQ-4.18.2 - nominal current	≤ 75	46	mA
BLV.QM-REQ-4.18.3 - actuation time	3 ≤ t ≤ 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
BLV.QM-REQ-4.18.7 - no damage	(ok)	ok	
BLV.QM-REQ-4.18.8 - total dose	20.000	21.502 (sensors) 23.200 (motor)	rad rad
BLV.QM-REQ-4.18.9 - ext. report	ext. report	Radiation Summary	

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

